DEVELOPMENT OF A SYSTEM FOR MONITORING THE PERFORMANCE OF INDONESIAN SCHOOL TEACHERS AND VILLAGE HEALTH WORKERS IN THE PROVISION OF SELECTED DENTAL SERVICES

Zaura Anggraeni Matram

B.D.S. University of Indonesia

Indonesia

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SIGNED STATEMENT

This research report is submitted in partial fulfilment of the requirements of the Master of Dental Surgery of the University of Adelaide.

This report contains no material that has been accepted for the award of any other degree or diploma in any university. To the best of my knowledge and belief, this report contains no material previously published, except where due reference has been made in the text.

ZAURA A. MATRAM

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SUMMARY

The Indonesian Government is developing a national dental system that requires extensive input from dental auxiliaries, teachers and village cadres. Apart from educational roles, teachers and cadres have an important function in the detection of common oral disorders, the referral of cases requiring emergency treatment, and the provision of oral hygiene services such as calculus removal.

The use of teachers and cadres to perform these roles is essential if basic dental services are to be extended to the Indonesian population of about 160 million with the limited financial resources available. A similar approach is being followed by other countries in the region where there are analogous demographic, financial and dental health problems. It would seem important, given the widespread commitment to this innovative strategy, that there be suitable monitoring systems to ensure that a satisfactory quality of service is maintained and that other service objectives are achieved.

It is apparent from the literature that the traditional 'Western' curative approach would be too costly for many developing countries and may not have the preventive impact desired. Various types of auxiliaries have been introduced to 'Western' countries in an endeavour to meet community demands for service at a manageable cost. However, some dentists have raised questions about the use of auxiliaries instead of dentists, particularly as related to the quality of services provided and their effectiveness and efficiency in meeting programme objectives.

The role of dental information systems has been shown to be indispensable in monitoring the quality, effectiveness and efficiency of

services provided by dentists and auxiliaries. In particular, the information system in the South Australian School Dental Service has been used extensively to address questions about service performance raised at a political level. The information system has enabled the dental administration to monitor the performance of dental auxiliaries in the Service and to ensure that adequate standards are maintained.

Aspects of the South Australian dental information system would appear to have application to Indonesia, although requiring modification to meet Indonesian requirements. However, this system was developed principally to evaluate conventional clinical services. There remains the need to develop systems for monitoring the provision of services by teachers, cadres and other 'outreach' workers.

The studies described in this thesis were designed to test models for monitoring the performance of these 'outreach' personnel. In the first study, 100 school children were each examined by a dentist, dental nurse, cadre and school teacher under normal field conditions to evaluate the diagnostic performance of the teacher and cadre. Assessments of the 'sensitivity', 'specificity' and 'predictive value' of the examination findings of these personnel were undertaken, using the dentist and dental nurse as absolute standards. In particular, there was evaluation of the performance of these personnel in identifying patients with carious lesions, patients in need of emergency care, patients with calculus, and patients with gingivitis. The size of the sample of children was the maximum thought to be feasible under normal field conditions in Indonesia. The use of sextants of the mouth and dichotomous scoring systems simplified the examinations and increased the practicality of the model. The merits of this evaluation model are discussed.

In the second study, a model for evaluating the performance of cadres and other 'outreach' workers at calculus removal and the provision of accompanying oral hygiene instruction was tested. Specifically, 150 children with calculus were allocated to three groups of equivalent size. One group was exposed to scaling and oral hygiene instruction from a dental nurse, whereas a second group received similar services from a cadre. The third group was designated as a control. The candidate obtained baseline and post-treatment assessments of calculus, plaque and gingival status 'blind' (i.e., without knowledge of the group affiliation of individual children). It was found that simple comparisons of post-treatment assessments provided a valid indication of treatment outcomes. This was evident from comparisons of results with those from more complex multivariate analyses using all available data. It was considered that these simple comparisons would be feasible under normal field conditions in Indonesia.

While both models were evaluated favourably in these pilot studies, a further broader study is recommended, covering a wider range of field conditions in Indonesia. The desirability of similarly testing a wider range of information systems in Indonesia, and further developing a central research and evaluation unit to oversee these systems, is discussed.

I. INTRODUCTION

The global objective of Health for All by the Year 2000 was adopted as a guiding principle in the formulation of the Indonesian National Health System policy document in 1982. This document describes in general terms the strategies and organizational developments that are to be followed by the national health system in order to achieve an optimum level of health for Indonesians (Ministry of Health, Indonesia, 1982).

As part of this plan, there is the intention to make adequate oral health care readily available to the whole population. This will be a difficult task since Indonesia has a moderate prevalence of oral diseases, scarce economic resources, and a large population extending over a vast archipelago. The present dental workforce is limited in size and not distributed evenly throughout the population (Directorate of Dental Health, 1982).

Dental services are being planned to conform with the overall priorities and strategies of the National Health System. Thus emphasis is being placed on rural and poor urban areas through the development of primary dental health care services (Directorate of Dental Health, 1982; Tomasowa, R., 1981a). Affirming this direction and for economic considerations, services are being decentralized and developed through the use of dental auxiliaries. There is also extensive use of non-dental workers in non-clinical settings. This follows the formulation of the Village Community Health Development Programme in which village volunteers are trained to attend to basic health needs as outreach workers in their villages.

The major role of village volunteers is community health education, which encompasses the aspect of oral health. In addition, village volunteers and school teachers are trained to detect common oral diseases, provide simple preventive services, and refer appropriate cases for care by trained dental staff (Tomasowa, R., 1981a, 1981b, 1981c).

This approach is a departure from the approach traditionally followed in Western countries. It has been introduced so that a large country with scarce resources may be able to manage its dental problems with maximum efficiency. The programme endeavours to achieve full coverage of the population, without a need for extensive training costs, by relying on auxiliaries and village workers to provide routine services.

It is notable that this general approach is also being followed in other developing countries (Saparamadu, K., 1984; Songpaisan, Y., 1985; Mosha, H., 1984; Stephen, S., 1984). In view of the scarcity of resources in these countries, it is important that dental programmes are evaluated objectively. In particular, if an acceptable quality of service is to be provided, the performance of village workers and other non-dental personnel will need to be monitored and evaluated by trained dental staff. To do this, there is a need for monitoring systems that are both effective and practical in the context of these countries.

Systems for monitoring dental care exist, but they have been designed around Western modes of care. Guidelines and parameters for quality control have been published, but they tend to be directed at curative goals (Dunning, J., 1970, 1980; Soricelli, D., 1968; 1975; Cons, N., 1971; Bailit, H. et al, 1974).

The South Australian School Dental Service is known to have extensive systems for monitoring the performance of dental auxiliaries (Roder, D., 1977 thesis; Barmes, D., 1983; Personal observations, 1985). These systems are reviewed in this thesis and their applicability to Indonesia is considered. However, since dental services are not provided by community health workers in South Australia, there are no operational models that have been orientated towards these types of personnel.

Indonesian village workers have a central role to play in: (1) the detection of dental diseases and referral of cases to trained dental staff; and (2) the removal of calculus. For this reason, methods for monitoring and evaluating the quality of these services have been developed, field tested and described in this thesis.

The scientific basis for the dental strategies employed in Indonesia is not the principal subject of this thesis. However, since there has been recent debate in some dental circles about the importance of calculus removal in the control of periodontal disease, a brief discussion of salient references is attached (Appendix I.1).

II. REVIEW OF BACKGROUND INFORMATION

The need for dental services has become an issue of major concern in Indonesia, particularly in relation to the rural areas. Financial and geographic considerations have led to a different style of service delivery than in Western countries. It is clear that dental information systems will need to be tailored to this Indonesian style of service.

In this section of the thesis, the literature available on dental services and dental information systems in Indonesia is reviewed, as well as the literature on the modes of care and management information employed in some Western countries. On-site observations in Indonesia and South Australia are also reported.

II.1 REVIEW OF DEMOGRAPHIC FEATURES OF INDONESIA, ITS HEALTH AND DENTAL HEALTH SYSTEM, AND ITS DENTAL INFORMATION SYSTEM

II.1.1 General Profile of Indonesia

The following overview of sociodemographic and health-related features of Indonesia will provide a background for subsequent descriptions of the developing dental health system.

II.1.1.1 The Country and its Population

Indonesia is a tropical archipelago in South East Asia. It comprises over 13,000 islands extending over a vast area of nearly two million square kilometres (Fig. II.1). Large distances, stretches of ocean, and difficult terrain in many areas impede transportation and communication. These factors tend to slow the rate of national development, including the development of comprehensive health services.

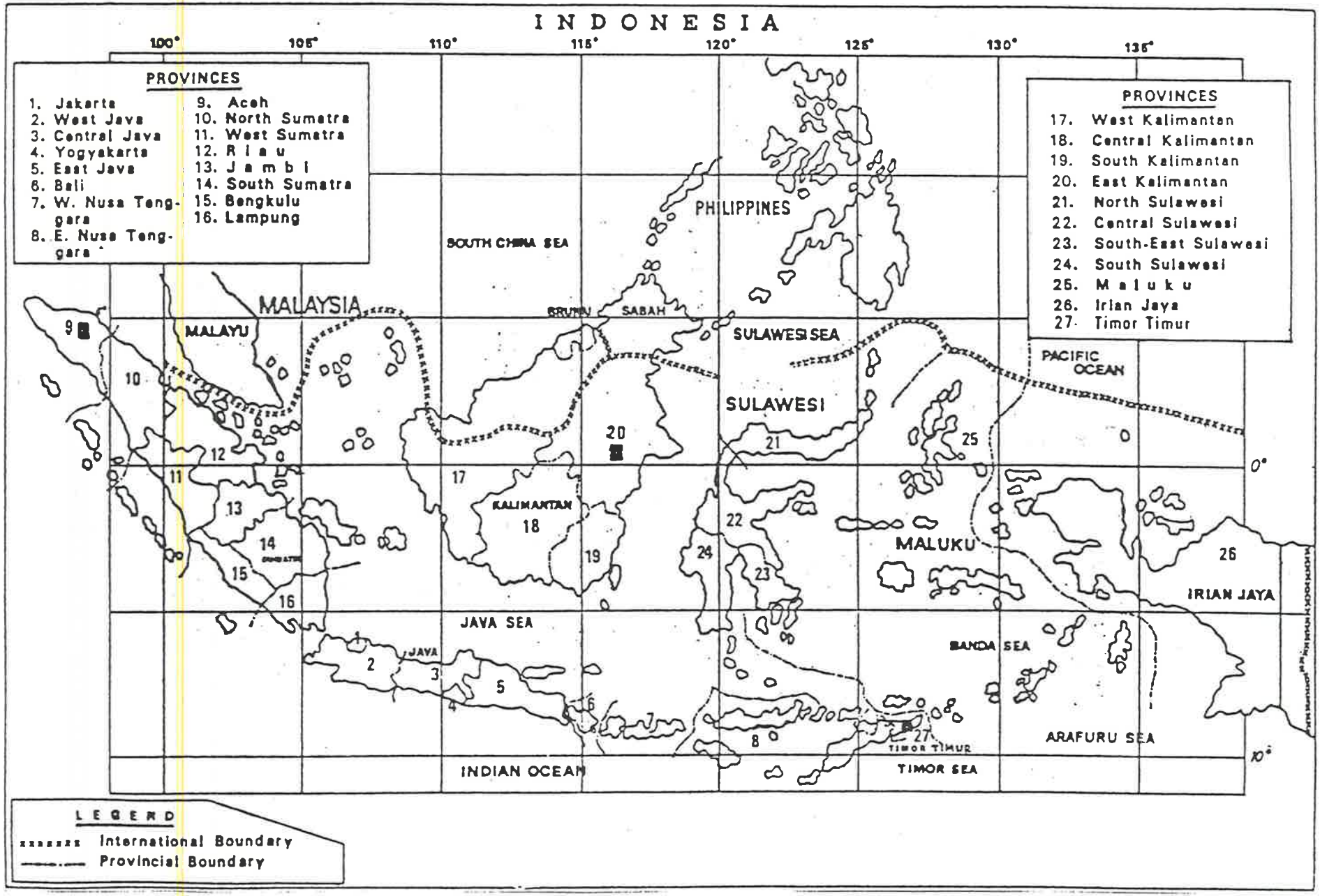


Figure II.1
MAP OF INDONESIA

Indonesia is the world's fifth most populous country. The mean annual growth rate during 1971-1980 was 2.3%, with a substantial variation occurring by locality. By the end of 1984, there were about 160 million inhabitants. By the year 2000, it is anticipated that Indonesia will have a population of around 200 million (Ministry of Health, Indonesia, 1982). Indonesia is considered to have a 'young population', insofar as nearly 42% are under 15 years of age (Nat. Stat. Bureau, 1982).

The population is unevenly distributed geographically, with approximately 60% residing on the island of Java. This island constitutes only about 7% of the total land mass of Indonesia (Table II.1). About 77% of the total Indonesian population is estimated to live in rural areas (Nat. Stat. Bureau, 1982).

Table II.1: The Population Density of Main Islands of Indonesia (per square kilometre) (Nat. Stat. Bureau, 1982).

Java	690
Sumatra	59
Sulawesi	55
Kalimantan	12
Other islands	3 to 19

These demographic characteristics have influenced the distribution of health providers. Most dentists reside in the cities and urban areas where there is a concentration of patients, and yet it is the rural areas that are considered to have the greatest absolute need for care (Directorate of Dental Health, 1982). Because it is not considered practical to rely solely on clinical services in large rural areas with a low population density, efforts are being made to foster a greater self-reliance

for dental and general health care. This approach has been incorporated into the national health plan for the period extending to the year 2000 (Ministry of Health, 1982).

II.1.1.2 The General Administration of the Country

For administrative purposes, Indonesia is divided into 27 Provinces, 300 Regencies, 3,408 Subdistricts, and approximately 62,660 Villages (Dept. of Information, Indonesia - 3rd Five-year Development Plan, 1979). Each Province administration co-ordinates between five and 35 Regencies or Districts, and each Regency includes from one to 20 Subdistricts. A Village is the basic administrative unit, generally supporting a population of between 500 and 10,000 people.

The administrative system for health services follows this general organizational structure. The community health centre in the Village is the smallest service unit and is responsible for the delivery of most health services to the local population (Ministry of Health, 1982).

II.1.1.3 The Economic Profile

The annual income per capita in 1980 was approximately U.S.$470 (Ministry of Health, 1982). Because income is unequally distributed across the population, most of the population would fall into a lower income bracket. This affects their ability to obtain health services.

It is readily apparent from Table II.2 that the net residue income (the allowance available to pursue various consumer items such as health care) is much smaller for the rural than urban population (Nat. Stat. Bureau, 1981).

Table II.2: Estimated per Capita Monthly Income (in Rupiahs) in 1978 (Nat. Stat. Bureau, 1981).

	Urban	Rural
Total	9220	4740
Expenditure on essentials*	7540	4155
Net residue	1680	585

* Essentials comprise: food, clothing, housing, energy and water.

Only about 0.6% of the population has been reported to use the National Dental Service each year, although a slightly higher proportion of about one per cent is thought to do so in the capital city (Noor, G.R. et al, 1976). These figures are much lower than the corresponding one of approximately 50% reported for many Western countries (Renson, C., 1974; Striffler, D., 1983; Cutress, T. et al, 1979 and 1983; Powell, R., and McEniery, T., 1985).

Studies in Western countries have suggested that cost is only one of many factors that determine dental care patterns. Educational status, occupation, degree of access to services, availability of services, previous dentist-patient relationships, fear, and various other sociocultural factors are all thought to have an important bearing on dental utilization (Blaikie, D., 1979; Davis, P., 1982; Hicks, N., 1981; Kegeles, S., 1974; Frazier, J., 1977; Richards, N., 1971). It would appear likely that a wide range of factors would also govern the extent of utilization of dental care services in Indonesia.

II.1.1.4 The Sociocultural Profile

In addition to its large population, Indonesia has a great sociocultural diversity. The country includes approximately 300 different ethnic groups which speak about 170 different dialects or languages.

The illiteracy rate for the rural population is about 35%. This compares with approximately four per cent for the urban areas. A large proportion of the rural population lacked access to formal education, although by the end of the third Five-year Development Plan in 1984, it was planned that every village should have a 'free' primary school (Dept. of Information, Indonesia - Third Five-year Development Plan, 1979).

It would appear that wide sociocultural differences and variations in educational status would affect health perceptions and behaviour, and that this would contribute to major differences in service utilization and health status in Indonesia.

II.1.1.5 General Health Profile

There have been improvements in life expectancy in Indonesia (Table II.3).

Table II.3: Life Expectancy of Indonesians at Birth (years) by Time Period (Ministry of Health, 1982).

	Male	Female
1971	45.0	48.0
1976-1981	46.5	49.4
1981-1985 (provisional)	48.9	51.9
2000 (estimated)	60.0	60.0

By the year 2000, it is anticipated that the life expectancy will reach 60 years of age. Although life expectancy is lower among rural than urban dwellers, it is predicted that this difference will diminish with increasing education.

The infant mortality rate was reduced from 137 per 1000 live births in 1961-1971 to 100 per 1000 in 1980. By the year 2000, it is estimated that the rate will have reduced by a further 50%. Infant mortality rates are lower in urban than rural areas, and are negatively associated with the educational level of the mother (Ministry of Health, 1982).

Available statistics show that malnutrition and infectious diseases are major causes of ill health. It is clear that many of these conditions would be amenable to simple treatment and preventive measures of a type that could be managed through very basic health-care services.

The major causes of death in Indonesia during 1980 included respiratory tract infections, diarrhoea, cardiovascular diseases, tuberculosis and tetanus. There was no substantial change in these causes of death between 1972 and 1980, although there was a slight trend away from the infectious diseases towards cardiovascular and other degenerative conditions (Ministry of Health, 1982).

Major health problems include malaria, dengue haemorrhagic fever, skin and eye infections, as well as diseases like measles and diphtheria which can be prevented by immunization.

A prominent underlying problem that contributes significantly to the high rates of mortality and morbidity in Indonesia is nutritional deficiency. Approximately 33% of children aged 1-4 years are estimated to suffer from calorie and protein deficiency. About three per cent of children in this age range would be severely malnourished. Iron deficiency anaemia affects about 30-70% of expectant mothers.

While many of the aforementioned problems are expected to decrease with time, it is anticipated that mental health problems, drug dependency and other problems that relate to a more modern urban life style will increase (Ministry of Health, 1982).

II.1.2 The Indonesian National Health System

II.1.2.1 The National Health System Policy Document

Based on the global objective of 'Health for All', the future national health development plan has been formulated in the Indonesian 'National Health System' policy document of 1982 to emphasize community-wide coverage. This document describes in general terms the strategies and organizational structures to be developed in the national effort to provide optimum health care to the entire population.

The document clearly states the emphasis that is to be put on specific strategies to promote the health of all Indonesians. The strategies are: (1) the widespread application of promotional and preventive services; (2) the development of active community participation and self-reliance; (3) the application of appropriate technology; and (4) the introduction of an adequate health information system.

II.1.2.2 The Health Care Services

The present health system is in a transitional phase between a Western approach and that envisaged in the 'National Health System' plan. Many aspects of the proposed system are already operational, particularly in the rural areas. However, there is still the intention to achieve a greater measure of decentralization, self-reliance and equity.

At present, rural health services are provided through a network of Public Health Centres (P.H.C., known as Puskesmas in Indonesia) in the Subdistricts, and of hospitals at the Regency and Provincial levels. At the Village level within the Subdistricts, Village-based services are being developed by utilizing lay volunteers to attend to the primary health care needs of the people. A system of referral is employed for patients who require more advanced treatment at the P.H.C.

Public Health Centre (P.H.C. or Puskesmas).

In 1984, there were about 5,400 P.H.C.'s in Indonesia (Repelita IV, 1985). At least one P.H.C. had been established for each Subdistrict in the country. As defined in the National Health Policy, a P.H.C. is the smallest health unit in the community. These units provide Subdistricts with comprehensive basic health services, including general curative services, maternal and child care services, family planning advice, communicable disease control measures, hygiene and sanitation services, health education, public health nursing, nutritional counselling and school health services. They also undertake data collection for the planning and evaluation of services. In addition, P.H.C.'s play an important role in the promotion of active community participation.

A full complement of P.H.C. staff would comprise one physician, a nurse, a midwife, several auxiliary nursing personnel, a sanitary inspector, a dental nurse (to be shared by four to six P.H.C.'s), and an administration clerk. This level of staffing is yet to be established for every P.H.C. P.H.C.'s are generally not equipped to provide in-patient care, but some are modified to deliver this service in areas of special need.

Dental services were provided by about 34% of P.H.C.'s in 1984. The dental units were staffed by a dentist and/or New Zealand-type dental nurse (Directorate of Dental Health, 1984, unpublished data).

On the islands of Java, Madura and Bali, one P.H.C. serves approximately 40,000 people, whereas in other sparsely populated islands, a P.H.C. may care for about 15,000-25,000 people. The optimum coverage is generally thought to be about 30,000 people under ideal circumstances.

The daily utilization of general health services in Indonesia is low, but there apparently has been a 10% increase since 1979 (Felix, A., 1985). Most visits are made by Subdistrict residents who live within 2.5 kilometres of the P.H.C. Notably, this distance would normally encompass fewer than 25% of the total Subdistrict population. During the last 10 years, an increase in public demand for dental care has been reported (Directorate of Dental Health, 1982).

To increase the proportion of the population covered by the P.H.C., Subcentres are being developed in the Villages. It is in these Subcentres that village health volunteers are being used most and active community participation is being promoted vigorously. Subcentres are co-ordinated and supervised by the P.H.C. at the corresponding Subdistrict

level. The primary health care provided at the Subcentre includes simple medical care, maternal and child care, including vaccinations, and nutritional and other health education. Where necessary, cases are referred to the P.H.C. for more advanced care. It was planned that by the end of 1984, every P.H.C. would have about four or five Subcentres. Subcentres are a crucial element in the Village Community Health Development Programme (popularly known as the PKMD).

Community Based Health Care

The community based health care programme has been developed to meet the strategies outlined in the 'National Health System' policy document. The PKMD was first introduced in 1972 to deal with health problems where resources were limited. However, this programme has only been pursued actively in recent times.

In the PKMD, Village volunteers are trained to provide for the basic primary health care needs of the people under the technical supervision of a primary health care nurse based at the Village Subcentre.

The participation of Village volunteers is not restricted to the delivery of care, but includes preventive services, planning and evaluation. Each community has its own social and cultural characteristics. It is considered that Village volunteer workers would be readily accepted in the Villages and would thus be well-placed to plan and provide services.

Hospitals

Government hospitals exist centrally and at the Provincial, Regency and Municipality levels. The hospitals provide services to individuals referred from P.H.C.'s. They also attend to the needs of

immediately adjacent communities by providing both in-patient and out-patient care.

Hospitals are generally staffed by one to five physicians. Although some of these are qualified as specialists, the availability of specialists is still minimal.

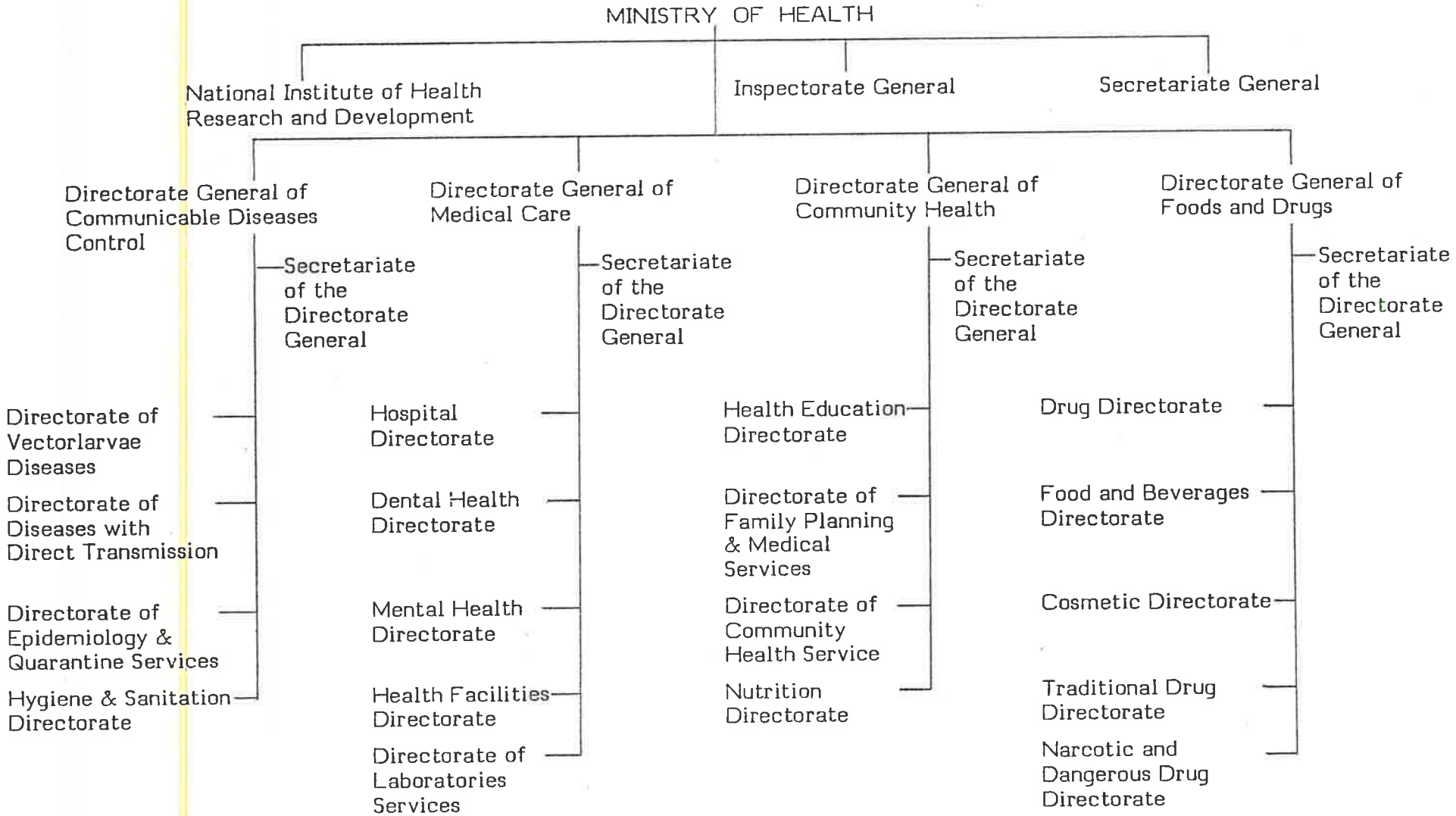
Hospitals at the Provincial level are better equipped than those in the Regencies and Municipalities. They therefore receive referrals from these regional institutions. The Central Hospital in Jakarta is the top referral hospital in Indonesia.

II.1.2.3 The National Health Management

The Government is responsible for providing public health care in Indonesia. The Ministry of Health decides on policies and strategies for national health development, in accordance with the overall plan of national development outlined in the prevailing Five-year Development Plan. The organizational structure of the Ministry of Health is illustrated in Fig. II.2.

Financial resources for the public health sector are provided by the Government (50%) and directly by the public (50%). Over four-fifths of Government funding is spent on three programmes, namely: (1) medical care through hospitals (38%); (2) health services through P.H.C.'s (28%); and (3) communicable disease control and associated environmental health activities (17%). In the present Five-year Development Plan (1985-1989), a greater proportion of government funds is being directed towards health development programmes for the rural and low income groups. This has been regarded as potentially the most cost-effective approach for developing countries with limited resources (Radford, A., 1984).

Figure II.2 Structure of Ministry of Health, Indonesia



Note: This structure from Directorate General levels, is generally applicable for the Provincial, Regency and Municipality levels.

General Remarks

There are marked regional differences in economic status, infrastructures of communication and transportation, educational levels, and religious and other customs in Indonesia. These and various psychological factors would affect the extent of utilization of health services. Utilization also would be affected by the levels of disease experienced, and the degree of accessibility of services. All these factors are likely to influence community perceptions of health and readiness to take health action (Hicks, N., 1981). It is therefore imperative that the planning of health services is based on sound situation analyses at the local level that take account of these factors.

The National Health Development Plan places priority on the rural areas and prescribes a greater community participation, partly by the involvement of local health workers. The national dental health programme is being developed to conform with these general policies.

II.1.3 The Indonesian Dental Care System

II.1.3.1 The Dental Health Profile

Dental disease has been ranked by the community in interview surveys as the most prevalent chronic impairment (Kartary, D., 1979). However, the demand for dental care is still low (Directorate of Dental Health, 1982). Reports of surveys of the prevalence and incidence of oral diseases are few. The ensuing review of dental health status is based on the limited data that are available.

Caries Experience

A recent survey covering 20 provinces indicated that the percentage of school children with a history of caries of the permanent

dentition ranged from about 45 to 75 per cent with the locality, but did not vary substantially between urban and rural areas (Table II.4). Seventy-eight per cent of 35-44 year olds in urban areas were shown to have a history of caries (Wibowo, D., 1984).

Table II.4: Caries Experience of Urban and Rural School Children and Urban Adults in Indonesia*, 1982.

Age (Yrs.)		(%)of persons with a History of Caries in the Permanent Dentition	Mean DMFT
Urban			
8	(n=2,097)	51%	1.08
14	(n=2,100)	73%	2.65
35-44	(n=2,049)	78%	4.61
Rural			
8	(n=1,999)	44%	0.90
14	(n=1,999)	68%	2.06

*Summarized from data for 20 provinces,

Oral Health Survey Report, D. Wibowo,

Directorate of Dental Health, Ministry of Health, Rep. of Indonesia, 1984.

An earlier study in 1972 had revealed a mean DMFT of 1.29 for eight year olds and of 3.22 for 14 year olds (Möller, I., and Effendi, I., 1972). Although there appears to have been minor changes in the caries rates experienced by Indonesian children since 1972, they may not represent any real shift in the prevalence of the disease. By comparison, children of the same age in non-fluoridated areas of South

Australia have experienced a marked decrease in DMFT values during the period from 1976 to 1984 (Table II.5).

Table II.5: Caries Experience of School Children in South Australia*, 1976-1984/5 (in non-fluoridated areas).

Age (Yrs.)	Year	Mean DMFT
8	1976	2.00
	1984	0.90
12	1976	5.53
	1984	2.58

* Annual Report of the South Australian Dental Service 1984/85.

Although factors like examiner variability and sample selection would probably have affected the comparability of the Indonesian and South Australian data, it would appear that presently South Australian children may have reached a similar caries experience to their Indonesian counterparts. Urban adults aged 35-44 years in Indonesia were determined to have a mean DMFT of 4.61. Corrresponding means for New Zealand and Brisbane, Australia, have been found to be 19.2 and 20.4 respectively (Cutress, T. et al., 1983; Powell, R., and McEniery, T., 1985).

Periodontal Status

There are no published data on destructive periodontal disease in Indonesians, although the 1982 survey of 20 provinces did record oral hygiene and the gingival status (Table II.6).

Table II.6: Oral Hygiene and Gingival Status of Urban and Rural School Children and Urban Adults in Indonesia*, 1982.

Age (Yrs.)		% of Subjects with Gingivitis	Mean OHI-S	Ging. Severity-% Mild	Mod.	Severe	Mean No. of Sextants Affected
Urban							
8	(n=2,097)	58	1.6	41	14	3	1.9
14	(n=2,100)	62	1.5	42	17	3	2.2
35-44	(n=2,049)	69	1.7	40	21	8	2.5
Rural							
8	(n=1,999)	63	1.8	42	18	4	2.1
14	(n=1,999)	69	1.7	45	19	6	2.3

* Summarized from data for 20 Provinces; Wibowo, D., 1984, Directorate of Dental Health, Indonesian Ministry of Health.

The prevalence of gingivitis and mean number of affected sextants in rural and urban children were not unsimilar. Because of methodological differences, direct comparisons cannot be made with data from other populations.

Calculus has been found to be highly prevalent in Indonesian children, being commonplace as early as eight years of age (Roder, D., 1983; Ministry of Health, Jakarta Regional Office, 1980). The oral hygiene status of Indonesian children is generally held to be poor. Data on other dental conditions are not readily available.

Despite a relatively low caries experience by Western standards, and possibly only a moderate severity of periodontal disease, the overall

need for services in absolute terms in a country as large as Indonesia is immense. With the limited resources available, Indonesia could not hope to meet this need through a sole reliance on traditional clinical methods. It is generally accepted, therefore, that emphasis should be placed on dental health education and on the provision of simple preventive services at the Village level.

II.1.3.2. The Public Dental Health Services

Approximately 3,500 dentists and 2,500 New Zealand-type dental nurses are presently available to serve a population of about 160 million in Indonesia (Indonesian Dental Assoc., 1984). It has been recognized that estimations of dental workforce requirements should not be based merely on the traditional dentist-to-population ratio, but should take account of actual oral health needs and the likely demands for care by the population (De Friese, G., and Konrad, T., 1981). Notwithstanding these broader considerations, the dental workforce availability in Indonesia would still be regarded as very low, particularly in the rural areas (Hassan, S., 1984; Isa, M., 1984; Directorate of Dental Health, 1982).

The uneven geographical distribution of dentists is compounded by the limited deployment of recent graduates, particularly females, who are unable to take up rural postings for various sociocultural reasons. Also there are problems when the number of Government clinics is insufficient to accommodate the numbers of new dental graduates (Directorate of Dental Health, 1984 - personal communication). This is an important factor because new graduates without government employment are generally not permitted to practise privately.

Due to the shortage of available services, efficiency has become an important goal to maximize population coverage. The following programmes have become principal features of the public dental endeavour:

1) The community dental care programme and the P.H.C. programme.

2) School dental services.

The Community Dental Care Programme and the Public Health Centre Programme

The general goals of the community dental care programme are to increase public awareness of oral health and decrease the prevalence of oral diseases. P.H.C. programmes are directed at improving oral health status in the community, partly by training and overseeing an outreach non-dental workforce which provides primary dental health care services in the Villages (Tomasowa, R., 1981a). The central goal of the community programme is to increase the community's ability and willingness to encourage its members to achieve good oral health through:

1. Self-care (by integrating oral hygiene attention, sound nutritional practices, and other health measures).
2. Self-detection of deleterious oral conditions.
3. Utilizing available dental services.

Primary dental health care has recently been introduced through Village volunteers (Cadres), who work under the technical supervision of dental nurses or dentists. After completion of a limited training, the cadre's tasks include: 1) dental health education of the community; 2) examination of the teeth, the gingivae and oral mucosa; 3) removal of

calculus; and 4) the referral of cases in need of more advanced care to the P.H.C. Each cadre has a dental kit which includes a mouth mirror, explorer, spoon excavator and hygienist scaler (Tomasowa, R., 1981b, 1981c).

No provision has yet been made within the information system to monitor the quality of services provided by cadres. Since cadres will have a fundamental role in the community dental care programme, it is important that their performance be monitored. In this way, the dentist or dental nurse will be able to ensure that an adequate quality of service is maintained.

The P.H.C. is the supporting unit for the community dental programme. The role of the P.H.C. includes: 1) the provision of treatment and management of referrals; 2) the supervision and co-ordination of the community dental care and the school dental programmes; 3) the training of a non-dental workforce; and 4) the promotion of active community participation.

School Dental Services

The school dental programme has been developed to care for primary school children. This is the age group (6-14 years) which has been assigned the highest priority for care. The service started as an incremental programme in which comprehensive treatment was provided to enrolled children. However, after 20 years of operation, the service was unable to cover more than two per cent of the total primary school population (Hamzah, B., 1976).

In the past few years, a 'Selective Care' approach has been developed as an alternative to the incremental care system. In 'Selective Care', comprehensive treatment is reserved for Year-6 students, with Year 1-5 students only receiving treatment on an emergency basis. Preventive services, including dental health education, fluoride mouth-rinsing and the removal of calculus, are provided to all primary school children, irrespective of school grade. Thus the success of 'Selective Care' will depend on the effectiveness of the preventive and promotional services.

School teachers are active participants in the 'Selective Care' programme. They play a role in oral health education, screening examinations and the referral of children for emergency clinical care, and the supervision of fluoride mouth-rinsing and toothbrushing programmes. The active participation of teachers has extended the availability of services, enabling dental staff to concentrate on the more technical aspects of dentistry.

'Selective Care' programmes have been introduced to several communities. For those areas which have not yet been serviced by these programmes, 'Integrated Oral Health Care' has been introduced. This is a minimal level of oral care provided by school teachers to their students.

'Integrated Oral Health Care' is limited to preventive and promotional services, comprising dental health education, fluoride mouth-rinsing and toothbrushing programmes, and the control of snack foods in the school environment. Teachers are supplied with a mouth mirror, explorer and tweezers so that they may participate fully in these programmes. There are plans to broaden the teachers' role to include the removal of calculus and placement of temporary fillings (Tomasowa, R., 1981c).

The utilization of school teachers in the provision of oral health care to primary school children is analogous to the employment of cadres in the provision of primary dental health care in the Village. 'Integrated Oral Health Care' is upgraded to 'Selective Care' as resources permit, and in accordance with community demand.

General Comments

School dental programmes entail the provision of care by non-dental personnel. The performance of teachers in the provision of care needs to be monitored to ensure that a satisfactory quality is maintained. The school dental programme should therefore include a suitable information system for monitoring purposes.

II.1.3.3 The Public Dental Health Administration

The development and co-ordination of national dental services are the function of the Dental Directorate of the Ministry of Health. The Directorate comprises four subdivisions which deal with the following policy areas: 1) community dental services; 2) school dental services; 3) promotional and preventive dental programmes; and 4) research and evaluation.

Co-ordination of the day-to-day operations of dental services is the responsibility of Provincial, Regency, Municipality and Subdistrict administrative offices.

II.1.3.4 The Public Dental Information System

The need for a health information system has been given serious consideration by the Indonesian Ministry of Health. One priority in the 1985-1989 Five-year Development Plan is the development of a new

health management system (Dept. of Information, 1985). This will require an increase in the human and physical resources devoted to the health information system. This is a significant step that recognizes the importance of a health information system in the management of health services (Thompson, G., 1978; Schulberg, H., 1979).

The present National Information System has several deficiences that have been generally acknowledged for some time. These include: 1) a lack of precise definition of the information required for planning and evaluation; 2) a limited co-ordination of existing information sub-systems; 3) only a poor definition of the tasks that should be performed at the various organization levels in the collection, processing and dissemination of data; and 4) insufficient qualified staff and allied resources to develop suitable information sub-systems (Soetopo, M., and Goenawan, S., 1978; Wasisto, B., 1984).

The deficiencies in the Dental Information System reflect those of the National Health Information System (Wasisto, B., 1984). Many observers have considered the present Dental Information System to be deficient (Hunter, P., 1980; Godfrey, K., 1981; Roder, D., 1983). With the increased size and complexity of dental services, an effective and efficient Dental Information System is a priority requirement (Siagian, B., 1984).

The main deficiencies of the Dental Information System are considered to include the following:

1. The system is administratively complex, requires a very broad range of data input, and is not seen to be useful by many data providers.

2. Although the data requirements are very broad, many data items needed for the monitoring and evaluation of dental programmes tend not to be available.
3. The data are generally held to be unreliable (Setiadi, L., 1985).

In an attempt to obtain a comprehensive set of data in the Dental Information System, many data items have been included which have only a limited relevance to the health management process. An extensive amount of effort is devoted to collecting data from dental records in various service units, such as the P.H.C.'s, school dental services, Village dental services and hospitals. As a result, the Ministry of Health receives a large volume of statistics. However, the interrelationships between various data items are not always apparent and only limited analyses are undertaken (Setiadi, L., 1985; Roder, D., 1983).

At present, the Dental Information System is in some respects more a collection of records than an information system. Schulberg (1979) has defined an information system for public services as 'a systematic method to collect, process, store, retrieve, and transmit the information on clients, staff activities and fiscal transactions that some specific functions of management require'. The present Dental Information System in Indonesia does not serve that purpose effectively.

To reduce the volume of recording and increase the usefulness of the information system, attention should be focussed on key indicators that relate to organizational objectives (W.H.O., 1978; W.H.O., 1981). Different levels in the organization will require different types of data. Provision will need to be made for these different needs in the new dental information system.

Every Indonesian dental service unit is presently required to record information on a variety of forms. This involves repetition and transcribing (Sukotjo, M., 1984), which increases the burden of the system at the various organizational levels.

Data are mainly gathered from the routine recording of oral conditions by different levels of the dental workforce. This has been done in a non-standardized manner, using imprecise definitions of terms (Effendi, I., 1984). Therefore, the resulting data have been difficult to interpret (Hunter, P., 1980; Roder, D., 1983). For valid interpretation, the data need to be accurate, appropriate and obtained in a precise manner (Lilienfeld, A., and Lilienfeld, D., 1980; Campbell, D., and Stanley, J., 1966; Riegelmann, R., 1981).

Dentists, dental nurses, school teachers and cadres all participate in the collection of data. However, a mechanism for ensuring that all staff, particularly non-dental workers, provide data of reasonable quality needs to be developed.

The present Dental Information System lacks the data necessary for epidemiological monitoring. This monitoring will be important if future administrators are to be able to answer such questions as the following:

1) Whether the priority given to dental care services in Indonesia is still appropriate in view of changing dental health patterns?
2) Which population groups are at greatest risk of bad oral health?

Epidemiological data from an information system should allow administrators to assess the effectiveness of the present dental system in

reducing the oral health problem (W.H.O., S.E. Asian Region, 1983; Roder, D., 1983). The flow of data in the present system has been regarded as inefficient. At the Subdistrict level, the completion of various data collection forms entails duplication (Sukotjo, M., 1984). The data forms are subsequently forwarded to successively higher administrative levels for aggregation. Although there are plans to automate this system, most data collection and processing is still manual (Wasisto, B., 1984).

The flow of dental information is mostly upward, with feedback to lower administrative levels occurring infrequently. A selective two-way flow of information would be desirable in which only the most crucial management information is included (W.H.O., 1978, 1981). There is the need to ensure that the feedback is informative, without an over-abundance of statistics that are difficult to interpret (White, K., 1978). Feedback should be beneficial to a wide range of users, including cadres, school teachers, clinic staff, administrators and politicians. The feedback should enable each level of the organization to better perform its tasks. This, in turn, could encourage an active participation of all staff in the information system (Roder, D., 1977 thesis).

II.2 DENTAL CARE SYSTEMS AND AUXILIARY-BASED PROGRAMMES IN HIGHLY INDUSTRIALIZED COUNTRIES

II.2.1 Introduction

Recent changes in the organization of dental care systems throughout the world have seen the development of various types of dental auxiliaries to cope with community treatment needs. The growth of dental auxiliary programmes has been accompanied by questions and criticisms from some members of the dental profession. Often the questions raised

on quality and other aspects have been important ones that have led to special studies.

The approach adopted by the Indonesian Dental Care System incorporates the use of an auxiliary workforce plus the extensive use of non-dental health workers. Because similar questions are likely to arise in Indonesia to those which have been directed at auxiliary-based programmes elsewhere, the development of dental auxiliary programmes in industrialized countries will now be reviewed briefly. Related problems and issues will be discussed.

II.2.2 General Overview of Dental Services in Western Countries

The growth of dental services in industrialized countries during the past 50 years has been influenced by a high demand for treatment (Ross, C., 1984; Wall, C., 1984; W.H.O. 1980; Sheiham, A., 1974; Barmes, D., 1975). The high incidence and prevalence of caries and periodontal disease and the untoward effects of tooth loss have led to the development of services that are largely curative, restorative and rehabilitative in orientation (Burt, B., 1983a; Ramfjord, S., 1968; McHugh, W., 1974; Burt, B., 1974; Blaikie, D., 1976). The cost of funding these types of services is high (McHugh, W., 1974). While curative benefits would have followed the introduction of these programmes, reviews of disease trends have failed to show demonstrable reductions in actual incidence which could be attributed to these systems (Cohen, L., 1980; Barmes, D., 1975; Burt, B., 1974; McHugh, W., 1974). There was also the observation that these systems often did not reach substantial proportions of the population (Davies, G., 1980; F.D.I., 1982; Sheiham, A., 1984; Stamm, J., 1978; Barmes, D., 1975). The need to review current dental systems and the organization of the workforce has therefore been emphasized (Cohen, L., 1980; Davies, G., 1980; Sheiham, A., 1974; Stamm, J., 1978; Dunning, J., 1976).

Generally, the style of the dental care system reflects the sociocultural, economic and political climate of the host country (Cohen, L., 1980; Barmes, D., 1975; Sheiham, A., 1974). Oral health care systems in industrialized countries have been classified into three types (Barmes, D., 1975; W.H.O., 1965; Sheiham, A., 1974). Type 1 includes systems that are based on a free-enterprise economic policy. The majority of the population bear the direct responsibility for defining their needs, expressing a demand for care, and financing their care. The predominant type of employment is private practice and the type of service has a major curative component (Sheiham, A., 1974; Dunning, J., 1976; Burt, B., 1974; Stamm, J., 1978). Historically, auxiliary workforces have not figured prominently in Type 1 systems, but more recently, dental hygienists and 'Expanded-Function Dental Assistants' have been more widely accepted (Burt, B., 1983c; Elderton, R., 1974).

The community-wide distribution of care in Type 1 systems is invariably uneven (Davies, G., 1980; Barmes, D., 1975; Dunning, J., 1976). Several reviews have discussed the possible reasons for a low utilization of services. They include fear, cost, and educational and sociocultural barriers (Hicks, N., 1981; Richards, N., 1971; Dunning, J., 1970). Changes in methods of payment and in the organization of the workforce are being considered in some countries in an attempt to increase service utilization and population coverage (Davies, G., 1980; Dunning, J., 1979; Stamm, J., 1978).

Type II systems operate in countries where a free-enterprise economic system prevails, but where social philosophies support the active involvement of Government in the provision of health services. Dental personnel are remunerated by the Government, but they are not

government employees. Social security schemes play a major role in health provision and there is a strong public health orientation in dental programmes (Sheiham, A., 1974; Burt, B., 1974; Kostlan, J., 1974; Barmes, D., 1975). In the United Kingdom, where this type of system has operated, 45% of the community have sought dental care each year, even though the full range of dental care was accessible to the entire population (Renson, C., 1974). Although an auxiliary workforce may be utilized in this type of system, most care is provided by dentists.

In Type III systems, the provision of health care is predominantly a governmental responsibility. Every citizen is eligible for a service at no direct charge through public clinics. Barmes suggested that these types of systems tend to be associated with a more widespread utilization of auxiliaries and a greater preventive orientation (Barmes, D., 1975). However, even in these systems, the majority of dental personnel are dentists and the types of services are still predominantly curative.

II.2.3 The Development of an Auxiliary Workforce

Although there are major differences between dental care systems in industrialized countries, the predominant type of treatment is curative and the principal provider is the dentist. It is perhaps relevant to observe in this context that all these systems appear to experience difficulties in containing costs. The need for alternative types of delivery systems and workforces that are less costly, and yet potentially effective and able to cover wider sections of the population, has been discussed (Davies, G., 1980; F.D.I., 1982; El-Zahwary, M., 1982). Many countries have attempted to extend services at relatively low cost by introducing operating and non-operating types of auxiliaries (Dunning, J., 1972; Roder, D., 1978; Bailit, H., 1982). Operating auxiliaries are defined as those who

are permitted to deliver certain treatments under the direction and supervision of a dentist. Non-operating auxiliaries are defined as those who assist dentists or operating auxiliaries in their clinical work, but are not permitted to perform any treatment directly (W.H.O., 1968).

II.2.3.1 Types, Training, Duties and Supervision of Auxiliaries

A. New Zealand-type Dental Nurse

New Zealand has been regarded as a pioneer country in the development and deployment of dental auxiliaries in public dental care programmes (Burt, B., 1983c; Roder, D., 1978). The training of New Zealand-type dental nurses started in 1921. Many other countries followed this lead, with some variations in length of training and duty specifications to suit local requirements and attitudes (Elderton, R., 1974; Butler, N., 1977; Roder, D., 1978; Burt, B., 1983c; Myers, S., 1973).

In New Zealand, the training covers a two-year period and prepares nurses to undertake oral examinations, treatment planning, prophylaxes, preventive treatments, cavity preparations and placements of fillings, pulp-capping, introductions of local anaesthesia, extractions of primary teeth, and the provision of health education. Children with complex treatment needs are referred to a supervising dentist. Upon the completion of their training, dental nurses are employed by the Government in a school clinic. The nurse works quite independently of the dentist, who may provide general supervision for about 50 auxiliaries.

The nurse has been responsible for the care of approximately 400-700 school children, and holds the status of a school staff member. Using this approach, 95% of primary school children in New Zealand receive dental care on a regular basis.

The New Zealand-type dental nurse was introduced to the South Australian School Dental Service in 1967 (Roder, D., 1973). The South Australian nurse, known as a dental therapist, has a similar training to the New Zealand nurse. Service deployment is also similar, although therapists are supervised more closely by dentists. While dental treatments are provided independently by the therapists, specified duties in diagnosis and treatment planning are carried out by the dentist, who supervises an average of seven therapists distributed across several clinics. Following the introduction of these auxiliaries, an 83% coverage of the primary school population of South Australia was achieved (South Australian Dental Service, 1983-84).

Other modifications of the New Zealand-type nurse exist in the Saskatchewan Province of Canada, and in England where the nurses are called 'New Cross Auxiliaries'. The principal difference between these schemes appears to be the degree of dentists' supervision (Burt, B., 1983c).

B. Dental Hygienist

A training course for dental hygienists was first introduced in the U.S.A. in 1914 to assist dentists in private practice. They are trained primarily in the prevention of dental diseases, the treatment of periodontal disease (excluding complex surgical care), the provision of dental health education and various other sundry duties (Burt, B., 1983d; Elderton, R., 1974; McIntyre, J., 1982). Hygienists have been widely accepted in the U.S.A., England, Europe, Canada, Japan and Australia, although the length of their training varies with the country from a few months to a maximum of four years (W.H.O. 1959; Elderton, R., 1974; McIntyre, J., 1982, 1984).

Irrespective of the length of training, hygienists are generally required to work under the direct supervision of a dentist. The hygienist has a more limited scope of duties than the New Zealand-type dental nurse, and is less independent of the dentist.

C. Expanded Function Dental Assistant (E.F.D.A.)

This operating type of auxiliary was developed recently in the U.S.A. and Canada, in response to an increasing demand for efficiency in the provision of dental services (Abramowitz, J., and Berg, L., 1973; Burt, B., 1983d). Their duties vary but may include the placement of rubber dam, the insertion of filling materials into cavities previously prepared by the dentist, taking impressions, and exposing radiographs. Studies have shown that the employment of E.F.D.A.'s can substantially increase productivity (Elderton, R., 1974; Taylor, L., 1976; Abramowitz, J., and Berg, L., 1973).

Thus, within the dental care systems of industrialized countries, three main types of dental auxiliary have emerged this century in response to different needs. Generally, the New Zealand-type nurse has been trained and employed in public health services whereas the hygienist and E.F.D.A. have been employed in private practice. The degree of supervision appears to depend not only on the auxiliary's level of training and the type of service setting, but also on the prevailing sociopolitical climate.

II.2.4. Issues Raised in Relation to Auxiliary-based Programmes

The development of dental auxiliary programmes was often accompanied by a debate of several issues. Questions were frequently directed at the quality of the care provided by auxiliaries and the cost-effectiveness of auxiliary-based programmes. The community

acceptance of auxiliaries as dental care providers was also questioned by some dentists. These issues are now discussed in sequence.

Quality of Care

Concern has been expressed that the introduction of operative dental auxiliaries may lead to a decrease in the quality of care (Burt, B., 1983c; Roder, D., 1977 and 1980). Although numerous reviews of the quality of care provided by dental nurses and therapists have been reported, some did not use well-defined standardized criteria in the evaluation process (Burt, B., 1983c; Roder, D., 1978). Nevertheless, these reviews have tended to indicate that the care provided by dental nurses has been effective and of a good quality (Friedman, J., 1972, Barmes, D., 1983; Fullton, J., 1951; de Liefde, B., and Ritchie, G., 1984).

The quality of care provided by hygienists has not been so rigorously assessed, however, possibly because most of them are in private employment (Burt, B., 1983d). The trend for an increasing demand for hygienists in the U.S.A. seemed to indicate that these auxiliaries had gained a high measure of dentist acceptance (Elderton, R., 1974).

The quality of performance of the E.F.D.A. has been assessed in numerous studies and found to be acceptable (Hammons, P., and Jamison H., 1967; Lotzkar, S., 1971a, 1971b; Abramowitz, J., and Berg, L., 1973), although Roder has cautioned against an over-confident generalization of findings from isolated experiments to the results obtained in actual working environments (Roder, D., 1978).

It appears that with appropriate training, auxiliaries can provide acceptable results. However, it is also clear that standardized methods of

quality assessment need to be introduced if appropriate evaluation of the quality of care provided by these and other dental personnel is to be maintained.

Cost Analysis (Efficiency)

The utilization of dental nurses and dental therapists has been shown to be more economical than the traditional dentists' service (Burt B., 1974; Dunning, J., 1972; de Liefde, B., and Ritchie, G., 1984). It has been reported that a 45% cost saving was achieved in South Australia when care was provided by dental therapists instead of dentists (Roder, D., 1977).

Although these analyses did not always take account of the costs of training, the working life span of the nurses, the costs of facilities and numerous other cost factors, their findings were consistent. Roder analysed the South Australian School Dental Service programme and found that the service provided by dental therapists was more economical than a hypothetical alternative based on a fee-for-service schedule. Using increases in productivity as another indicator, Davies has reported that the utilization of hygienists and E.F.D.A.'s also offers economical advantages (Davies, G., 1980).

Level of Community Acceptance

Initially, the introduction of auxiliaries was strongly resisted by dentists in some countries. The resistance was most apparent in the U.S.A. (Roder, D., 1978; Burt, B., 1983c, 1983d; Taylor, L., 1976). Gradually, a greater level of acceptance was gained in other ~~Western~~ industrialized countries, such as Australia, Canada and the United Kingdom. The utilization of more auxiliaries to further increase the efficiency of dental systems continues to be advocated (Davies, G., 1980; W.H.O. 1980; F.D.I. 1982).

II.2.5. Summary

1. The development of dental auxiliaries was mainly brought about by a demand for more dental services and a desire to contain costs.

2. Auxiliary-based programmes have gradually gained recognition and acceptance from the dental profession and health planners for their effectiveness, efficiency and population coverage.

3. Regardless of differences in supervision, acceptable levels of quality have been reported, although methods of evaluation have often been largely subjective.

4. The issues of quality of care, effectiveness and efficiency will continue to be present, especially when a workforce with minimally training is introduced. The need for a monitoring system to evaluate these aspects objectively is apparent.

II.3 THE DENTAL INFORMATION SYSTEM IN THE SOUTH AUSTRALIAN SCHOOL DENTAL SERVICE (SA-SDS)

II.3.1 Introduction

As stated previously, a range of questions has tended to arise when steps have been taken to develop dental auxiliary programmes around the world. These have usually been directed at the quality of the care provided by auxiliaries, the effectiveness and efficiency of auxiliary-based services, and the level of acceptance of the community of auxiliaries as care providers.

The purpose of this part of the thesis is to review briefly some organizational aspects of the SA-SDS and the role of its information system. The part played by the information system in addressing questions on quality, effectiveness, efficiency and social acceptability is discussed. It is predictable that similar questions will arise in relation to the development of Indonesian dental services and so appropriate information systems will be needed to provide answers in that country.

II.3.2 General Overview of the SA-SDS

The SA-SDS was established in 1922, mainly to alleviate shortages of dental manpower in rural areas. For many years, the Service provided dental care to primary school children only when they lived in areas remote from private dental practices.

Prior to the introduction of mobile dental clinics in 1959, portable dental kits were used by travelling dental staff. In 1969, when static school-based clinics were first introduced, they were staffed by dental therapists (New Zealand-type dental nurses) and dentists. Since then, the SA-SDS has continued the practice of employing both dentists and therapists (Roder, 1976, Unpublished paper).

Therapists were introduced to the SA-SDS mostly to reduce the cost of care and to increase coverage of the childhood population (Roder, D., 1978; Blaikie, D., 1974). Prior to the introduction of therapists, the SA-SDS was unable to cover more than three per cent of the primary school population in any one year. By 1980, however, virtually all primary school children in South Australia were able to gain access to dental care through the Service (Roder, D., 1980).

The main aim of the Service has been to obtain and maintain good dental health in children. Coverage of preschool and primary school children was to be achieved by 1980, and this was to be extended to secondary school children up to (and including) the year in which they turned 16 years.

For evaluation purposes, a range of specific objectives was defined as follows:

1. All preschool and primary school children were to receive dental care by 1980, and all students up to 15 years of age were to receive this care by 1985.
2. The dental health thus achieved was to serve as a basis for life-long good dental health.
3. There was to be a reduction in such barriers to dental care as fear, cost and geographic isolation.
4. The quality of school dental care was to be high by conventional clinical standards.

School dental care is now provided through 103 static clinics scattered throughout South Australia. Several mobile clinics are also used, particularly in remote rural areas (SADS 1984/1985). Each static clinic is staffed by a team of one or more therapists and dental assistants. Government dentists are responsible for the overseeing of the dental therapists in these clinics. Each category of dental personnel has clearly defined duties (Appendix II.1).

The organizational structure of the SA-SDS has several levels. The Central Office and Regional Dental Officers (RDO's) administer the

Service at the State and regional levels respectively. There are five administrative regions that cover the whole State, each headed by a RDO.

RDO's oversee from six to 10 District Dental Officers (DDO's) who administer the dental programmes in their districts. Districts normally have several school-based clinics staffed by dental therapists and nurses. DDO's each supervise an average of seven therapists. Thus clinical services are provided by hierarchical teams of dental operators (Dooland, M., 1985).

A certain degree of standardization of operational procedures has been introduced to the SA-SDS for management purposes (Appendix II.2). A balance has been sought between the need to standardize and yet retain sufficient flexibility and local autonomy to encourage staff initiative and the adaptation of programmes to meet local circumstances. A degree of standardization is considered essential for the following purposes:

1. To facilitate the movement of operators between clinics.
2. To increase administrative simplicity and convenience.
3. To maintain a minimum standard of care.
4. To facilitate the monitoring of services.
5. To obtain accurate and reliable data.
6. To promote organizational efficiency.

As indicated, there is the need to obtain a balance between standardization, flexibility and local autonomy (Thompson, G., and Handelman, I., 1978). This has been attempted in the SA-SDS (Appendix II.2).

Although the Service can vary to some degree in its operational procedures from area to area, its objectives are uniform. There is the need for effective monitoring systems and continual communication between the central and regional staff to ensure that these objectives are met effectively and efficiently (Roder, D., 1977, thesis; W.H.O., 1981).

II.3.3 Management Control and the Role of the Information System

The Research and Evaluation Unit of the SA-SDS has developed an information system to monitor the appropriateness, effectiveness, efficiency, and quality of school dental care. These are generally recognized to be the principal factors to address when assessing the performance of a dental programme (W.H.O., 1980, 1981; Dunning, J., 1980).

The following aspects are reviewed routinely by the Research and Evaluation Unit:

1. To evaluate effectiveness -
   - (a) the number of children treated.
   - (b) the level of enrolment of children in the SA-SDS (also an indication of social acceptability).
   - (c) the caries incidence and experience (also an indicator of appropriateness).
   - (d) other measures of dental status, such as indices of oral debris, calculus, gingivitis and hypoplasia.

   The data are provided by clinical staff using carbon copies of dental examination records and other source material (Appendices II.3 and II.4).

2. To evaluate efficiency -

(a) the number of patients per operator.

(b) the service output per operator.

(c) the cost of care as compared with a hypothetical fee-for-service alternative.

Source data are gathered from so-called 'day books' which are maintained at the clinic level. These include records of all the services provided by individual operators (Appendix II.4).

3. To evaluate the quality of care -

Information pertaining to:

(a) diagnostic performance.

(b) the quality of restorative care.

(c) compliance of staff with clinic policies on 'service mix'.

Because of the emphasis that is likely to be placed on the quality of services in Indonesia, especially services provided by village volunteers and other non-dental personnel, the monitoring of quality in the SA-SDS will be reviewed in greater detail than other aspects of the Service.

The quality of care provided by therapists is assessed by DDO's, RDO's and Central Office staff on a periodic basis. Source information comes from:

1. Routine Examinations of Patients.

Numbers of teeth in need of extraction for pathological reasons, DMF and df values, oral debris levels, numbers of teeth with defective restorations, and other oral status measures are used to monitor trends in the dental health of therapists' and dentists' patients. This information is obtained by the Research and Evaluation Unit from carbon copies of routine examination

records (Appendix II.3). From this information, general inferences are drawn about the quality of the care provided.

(2) Formal Duplicate Examinations of Samples of Patients by Therapists and DDO's.

Comparisons between dentists' and therapists' findings highlight differences in diagnostic performance and in assessments of the need for care (Appendix II.5). Through discussions of these differences, a measure of appraisal and control of the quality of services is introduced.

(3) Treatment Cards.

Data from treatment cards show whether therapists are complying with clinic policies on the 'mix of services' to be provided, the maximum intervals between examinations, the updating of medical histories, and other operational aspects (Appendix II.5). The numbers of teeth requiring pulpal treatment or replacement of defective restorations among those patients with a longstanding history of school dental care are also used as an index of quality.

The statistical findings from these reviews are sent by the Research and Evaluation Unit to the RDO's, who then arrange follow-up discussions with the DDO's concerned. Thus the RDO's can remain 'in touch' and influence the type and quality of services provided in the districts in their regions.

In earlier years, Central Office staff would participate with RDO's in duplicate examinations of samples of patients. Findings would be

compared and discussed in order to achieve some measure of quality appraisal and control. This practice has since been discontinued. RDO's may still undertake duplicate examinations with the DDO's in their regions prior to the DDO's involvement in duplicate examinations with therapists. Accordingly, some degree of supra-district supervision is still maintained.

II.3.4 Collection and Analysis of Data in the Information System

This is the principal responsibility of the Research and Evaluation Unit. Data collection, analysis and reporting have become a routine standardized process in the Service.

Dental health data are obtained in precoded form from routine dental examinations, using carbon copies of the normal examination record. This avoids a need for repetitious recording. The approach has proven to be practical and efficient.

The flow of data has been enhanced by sending the data directly from the clinics to the Research and Evaluation Unit. Accordingly, delays that would occur, should data be sent through the hierarchical administrative chain, are avoided. Also, a high level of centralized automation has further increased the efficiency of the information system. It is relevant to note in this context that Thompson has reported how advances in computer technology during the 1960s and 1970s increased the desirability of centralizing data processing in large organizations (Thompson, G., 1978).

Through computerization, routine SA-SDS reports are produced quickly and forwarded directly to their target audiences, whether Central Office staff, RDO's, DDO's or therapists. This enables the whole

workforce to monitor organizational performance with regard to effectiveness, efficiency and quality of care. Comparisons can be drawn between the performance of different districts within the same regions, and between different regions.

Personnel at all organizational levels should participate in the evaluation process (W.H.O., 1981). In South Australia, this appears to foster a compliance of staff with overall SA-SDS policies and an intent to maintain a high quality of service (Dooland, M., Burrow, D., and Franklin, J., 1984).

Although extensive data are collected routinely in the SA-SDS system, the need for additional information would arise periodically. For example, information on the maintenance of recommended dental habits after patients leave the SA-SDS is not collected routinely (Roder, D., 1973, 1976, 1979; Sundram, P. et al., 1980). Specific surveys are required to collect this information. It is generally recognized, if routine information systems are not to become excessively burdensome, that supplementary surveys would be necessary from time to time for evaluation purposes (W.H.O., 1981).

II.3.5 Utilization of Data from the Information System

The SA-SDS Research and Evaluation Unit produces a wide range of statistical reports that bear upon the issues of quality, effectiveness, efficiency and social acceptability that commonly have arisen when dental auxiliaries have been introduced. The information system has provided data that have assisted the Service to respond effectively to formal external reviews (Public Accounts Committee, 1984; Barmes, D., 1983). In so doing, it has assisted the Service to account for its use of public money.

Information on workforce productivity and cost has enabled the efficiency of the Service to be demonstrated (PAC, 1984). Furthermore, information on workforce productivity has been crucial in workforce planning.

Data on caries experience and other oral health aspects have facilitated assessments of the effectiveness of the Service. The proportion of children enrolled in the Service has also been an important index of effectiveness and social acceptability.

II.3.6 Additional Comments

The SA-SDS information system is both comprehensive and practical. By making the system an integral part of day-to-day operations, avoiding repetition, and using automation, it has been possible to contain its cost to about 1-1½% of the total school dental budget (Roder, D., 1977).

The system appears to have facilitated an appropriate degree of central supervision and control in a dental programme where there is scope for substantial flexibility in operational procedures at the local level.

The involvement of all staff in information assessment appears to have been crucial in achieving a high measure of organizational direction and control.

II.4 DEVELOPMENT OF AN INDONESIAN DENTAL INFORMATION SYSTEM AND THE OBJECTIVES OF THE PRESENT STUDY

Decentralization of service provision through the extensive use of dental auxiliaries, school teachers and cadres is a central feature of the

strategy for making dental services available to all Indonesians. The role played by non-dental personnel is crucial and without precedent in Western countries (Radford, A., 1978; Songpaisan, Y., 1985; Saparamadu, K., 1984). It is clear that the performance of these personnel will require monitoring.

While the information system developed in the SA-SDS would be appropriate for monitoring the services provided by conventional clinical staff (Barmes, D., 1983; P.A.C., 1984; Roder, D., 1977), this system is not oriented toward outreach workers such as school teachers and cadres. It also has been mentioned previously that the present dental health information system in Indonesia is deficient in this regard (Setiadi, L., 1985; Siagian, B., 1984; Sukotjo, M., 1984; Effendi, I., 1984; Roder, D., 1983).

There is a need, therefore, for Indonesia to develop an information system that meets its own special requirements (Roder, D., 1983; Godfrey, K., 1981; Hunter, P., 1980). An Evaluation and Research Unit should be available to assist this process. Such a Unit could develop and co-ordinate the dental aspects of a total health information system. It could also assist in the planning and evaluation of services. Periodically, the Unit could implement special surveys to obtain dental health and related information not routinely available through the information system. In view of the limited resources available for dental care in Indonesia, considerable emphasis would need to be placed on cost-effectiveness as well as quality.

Apart from the need for valid and relevant data, there is the requirement for prompt analysis and timely feedback for management purposes (W.H.O., 1981; Thompson, G., 1978). As in South Australia, this

could be facilitated by providing key data directly to the Evaluation and Research Unit for processing. This would avoid the delays that are unavoidable when material is forwarded through various levels of administration (Roder, D., 1977 - thesis; Dooland, M., and Burrow, D., personal communication).

Feedback from a central evaluation Unit could be provided to Provincial, Regency and Municipality administrative and service units, as well as to community health workers in each Subdistrict. Comparative data from other areas would assist staff at the various organizational levels to assess the performance of the dental services in the localities for which they are responsible.

Because Indonesia covers a vast geographic expanse, there is the need for considerable local autonomy in the administration of services. Through a centralized data processing and feedback mechanism, local units could monitor their services and respond promptly when remedial action was warranted. At the same time, the Central Administration in Jakarta would have data available to maintain an appropriate level of central administrative supervision.

Two research investigations were undertaken by the candidate to develop simple yet effective quality review methods to meet Indonesia's special requirements. The specific objectives of the studies were:

1. To develop and test in the field a method for monitoring the performance of dental nurses, village cadres and school teachers at detecting common dental diseases and conditions, and those cases indicated for referral.

2. To develop and test in the field a method for evaluating the performance of dental nurses and non-dental personnel in the removal of calculus and provision of associated oral hygiene instruction.

III. DEVELOPMENT OF MONITORING SYSTEMS THAT MAY BE APPLICABLE TO THE INDONESIAN DENTAL SERVICE

III.1 Introduction

It is apparent that Western-style information systems, such as the system in SA-SDS, would have application in Indonesia, at least in a modified form. This would mostly apply to the monitoring of conventional clinical services provided by dentists and dental nurses. Aspects like the patient load per operator, the 'mix of services' provided, and the clinical quality of these services could be monitored in this way.

Yet a central feature of the Indonesian Dental Service is the role played by non-dental personnel (e.g., village cadres and school teachers). This applies in particular to the examination and referral of individuals for clinic-based services, the provision of health education, and the removal of calculus. The use of non-dental personnel for this purpose is a new approach that should be monitored.

In Indonesia, the dentist attached to the P.H.C. (Puskesmas) is responsible for overseeing the quality of the care provided by dental nurses in that facility. Since nurses would relate more closely than the dentist to non-dental personnel in their day-to-day work, it may be more appropriate for nurses to be responsible for ensuring that the quality of the dental services provided by these personnel is adequate. Thus, the dentist (through the dental nurse) would only be <u>indirectly</u> responsible for overseeing these outreach services.

Principal areas of responsibility for non-dental personnel include:

(1) The examination of population groups at periodic intervals and the referral of appropriate individuals to the P.H.C. for clinical attention.

(2) The detection of carious lesions, gingivitis and calculus, as indicators of the need for health education and prophylaxes.

(3) The removal of calculus.

It is relevant to note, in this context, that many population groups reside in areas far-removed from P.H.C.'s in travelling time. Thus, the services provided by non-dental personnel in schools and village communities tend to be much more accessible and are likely to achieve a broader coverage of the population than clinic-based services. Ideally, the inconvenience of travelling to a clinic would be restricted very largely to those individuals with a confirmed need for clinical services (as assessed by these non-dental outreach workers).

The potential economic and health advantages of using non-dental personnel are attractive. However, the impact of the services provided in this way will depend on their quality. Clearly, there needs to be a system of monitoring this quality to ensure that it is adequate.

The present investigations were carried out in Western Java (Tangerang Regency) to test the utility of two simple systems for monitoring the quality of outreach services. The aspects addressed were:

(1) Study one - the detection of carious lesions, gingivitis and calculus by non-dental personnel.

(2) Study two - the removal of calculus by non-dental personnel and provision of accompanying oral hygiene instruction.

III.2 STUDY ONE: The Detection of Carious Lesions, Gingivitis and Calculus

III.2.1 Introduction

Since the dentist is ultimately responsible for the quality of care performed in a P.H.C., and the attention provided in schools and villages in the clinic-catchment area, it would be ideal if standards of quality set by the dentist could be followed. However, this will not apply totally. Dental nurses will vary in their diagnostic performance from that of their dentists. Similarly outreach personnel will not perform identically to their supervising dental nurses.

It should be possible through a monitoring system, however, to identify the extent of variation in diagnostic performance between:

(1) the dental nurses and their supervising dentists.

(2) outreach non-dental personnel and their supervising dentists.

(3) outreach non-dental personnel and their supervising dental nurses.

Where variations were found to be unacceptable, remedial action could be taken.

In this study, 100 children were each examined by a dentist, dental nurse, village cadre, and school teacher. The examinations were performed under normal field conditions in villages in the Tangerang Regency. Methods for assessing the extent of divergence of these personnel in the detection of caries, gingivitis and calculus were applied.

By treating either the dentist or dental nurse as an absolute standard, the sensitivity, specificity, and predictive values of the

assessments of non-dental personnel were explored. Because the concepts of sensitivity, specificity and predictive value are central to the evaluation model under study, these terms are now reviewed.

III.2.2 Sensitivity, Specificity and Predictive Value

Sensitivity, specificity and predictive value are often assessed to determine the diagnostic value of a test or examination. Sensitivity and specificity can be regarded as measures of the internal validity of a screening test (Grant, J., 1974; Thorner, R., 1967; Ronsohoff, D., 1978).

Sensitivity may be defined as the percentage found to be positive by a test or examination among all those people who actually have the disease (cell 'a', Table III.1). Accordingly, the detection of individuals with carious lesions would be regarded as 100% sensitive if all individuals with carious lesions were so classified (i.e., there were no false negatives; cell 'c'=0; Table III.1).

By comparison, specificity may be defined as the percentage found to be negative by a test or examination among those people who are actually free of the disease (cell 'd', Table III.1). Therefore, the detection of individuals with carious lesions would be 100% specific if all those without carious lesions were classified as caries free (i.e., there were no false positives; cell 'b'=0; Table III.1).

Ideally, a test or examination should have a 100% sensitivity and 100% specificity. However, this is often not possible (Galen, R., and Gambino, S., 1975; Thorner, R., 1967). A balance between these two aspects needs to be achieved in many situations. Changes that increase sensitivity will often tend to decrease specificity, whereas changes that

increase specificity will often tend to decrease sensitivity (Thorner, R., 1967).

Table III.1: Classification of Diagnostic Examination Results* (Thorner, 1967).

Examination Results	Disease Truly Present	Disease Truly Absent
Positive	a	b
Negative	c	d

* .. a : true positive findings.
b : false positive findings.
c : false negative findings.
d : true negative findings.

Sometimes a test may be 100% sensitive, but have limited utility because of a low specificity. In this case, all of those people with disease (true positives) will be detected, but the number of false positives will be high. As an extreme example, there would be no advantage in having a cadre examine individuals for referral if all individuals were to be automatically referred. While all those with disease would be referred, so would all those without disease.

Alternatively, a test may be 100% specific, but be too low in sensitivity. Again, as an extreme example, there would be no advantage in having a cadre examine individuals for possible referral if all individuals were automatically deemed not to need referral. In this case, all of those

free of the disease would not be referred (and therefore would not be subjected to unnecessary inconvenience), but none of those in need of clinical attention would be referred either.

By assessing the sensitivity and specificity of examinations by non-dental personnel, it should be possible to evaluate their performance. This will be important information for the supervisory dentists and nurses. Cut-off levels of sensitivity and specificity could be set by these supervising staff to indicate when follow-up action would be taken to modify the performance of non-dental personnel.

Where clinic staff were grossly overburdened with valid treatment requirements, it may be <u>especially</u> undesirable to waste clinic time and patients' time by referring (for treatment) those without treatment need. By comparison, where clinic staff have a very low treatment load, and little demand on their time, it might be better to err on the side of a high sensitivity, so that virtually all cases with a treatment need would be referred. This may be so, despite the unnecessary referral of some individuals without treatment needs.

Other factors, such as the seriousness of a disease, would need to be taken into account when specifying cut-off levels for sensitivity and specificity. Where a disease is serious, is relatively easy to detect, and is readily curable, and where false positive findings do not lead to serious psychological or economic side-effects, a high measure of sensitivity may be sought, notwithstanding a relatively low specificity. Alternatively, a high specificity may be sought (to the detriment of sensitivity) for diseases that are not serious, where treatment is of minimal value, and where false

positive findings could cause serious psychological or economic consequences to the individual (Galen, R., and Gambino, S., 1975).

Where there is 100% sensivity and 100% specificity, the predictive value of examination results would be 100%. In other words, all those individuals found to have a condition will truly have it, and all of those found to be free of the condition will truly be without it. The predictive value for positive findings is the percentage of positive findings that are accurate, namely: $\frac{a}{a+b}$ (Table III.1). By comparison, the predictive value for negative findings is the percentage of negative findings that are accurate, namely: $\frac{d}{c+d}$ (Galen, R., and Gambino, S., 1975; Hart, G., 1980, 1983).

Predictive values will vary with sensitivity and specificity, and also with the prevalence of the disease. The following formula derived from the Bayes' theorem* has been used to calculate predictive value:

$$\text{Predictive value} = \frac{(\text{Sensitivity})(\text{Prevalence})}{(\text{Sensitivity})(\text{Prevalence}) + (1-\text{Specificity})(1-\text{Prevalence})}$$

* .. Quoted from Hart, 1980.

For convenience, tables of predictive values for various levels of sensitivity, specificity and prevalence have been provided by Galen and Gambino (1975).

As an illustration, if 10% of a population were truly to have a carious lesion, and the sensitivity and specificity of the cadre's examinations were both 90%, the predictive value would be as follows:

(1) Where the cadre's finding is positive - a predictive value of 50%. This is calculated from the equation:

$$\frac{(0.9)\,(0.1)}{(0.9)\,(0.1) + (1-0.9)\,(1-0.1)} \times 100.$$

(2) Where the cadre's finding is negative - a predictive value of 99%. This is calculated from the equation:

$$\frac{(0.9)\,(0.9)}{(0.9)\,(0.9) + (1-0.9)\,(1-0.9)} \times 100.$$

However, these predictive values can be obtained more conveniently from Tables III.2 and III.3 respectively (Galen, R., and Gambino, S., 1975).

It is evident that the appropriate balance between sensitivity and specificity will depend upon various factors. Having determined what that balance should be, then it should be possible for clinical staff to use this criterion for assessing the performance of non-dental personnel in the detection of caries, gingivitis and calculus. This point will be expanded in the discussion section (III.2.5).

III.2.3 Materials and Methods

A. Personnel

For the purpose of this study, the candidate served as the supervisory dentist, whereas the Tangerang Regency, in cooperation with the University of Indonesia, provided a dental nurse, cadre and school teacher. All non-dentist personnel were selected on the basis of availability, but did not appear to be exceptional examples of their respective categories of workers.

Table III.2:

PREDICTIVE VALUE OF POSITIVES (IN PERCENT)
SENSITIVITY = 90%

SPECIFICITY (%)

Prevalence per 100,000	50.00	60.00	70.00	80.00	90.00	91.00	93.00	95.00	97.00	99.00
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	1
20	0	0	0	0	0	0	0	0	1	2
30	0	0	0	0	0	0	0	1	1	3
40	0	0	0	0	0	0	1	1	1	3
50	0	0	0	0	0	0	1	1	1	4
100	0	0	0	0	1	1	1	2	3	8
200	0	0	1	1	2	2	3	3	6	15
300	1	1	1	1	3	3	4	5	8	21
400	1	1	1	2	3	4	5	7	11	27
500	1	1	1	2	4	5	6	8	13	31
1000	2	2	3	4	8	9	11	15	23	48
2000	4	4	6	8	16	17	21	27	38	65
3000	5	7	8	12	22	24	28	36	48	74
4000	7	9	11	16	27	29	35	43	56	79
5000	9	11	14	19	32	34	40	49	61	83
10,000	17	20	25	33	(50)	53	59	67	77	91
15,000	24	28	35	44	61	64	69	76	84	94
20,000	31	36	43	53	69	71	76	82	88	96
25,000	37	43	50	60	75	77	81	86	91	97
50,000	64	69	75	82	90	91	93	95	97	99

Source: Galen & Gambino, 1975.

Table III.3.

PREDICTIVE VALUE OF NEGATIVES (IN PERCENT)
PREVALENCE = 10,000 PER 100.000

SPECIFICITY (%)	SENSITIVITY (%)															
	50	60	70	80	85	90	91	92	93	94	95	96	97	98	99	100
50.00	90	92	94	96	97	98	98	98	98	99	99	99	99	100	100	100
60.00	92	93	95	96	97	98	98	99	99	99	99	99	99	100	100	100
70.00	93	94	95	97	98	98	99	99	99	99	99	99	100	100	100	100
80.00	94	95	96	97	98	99	99	99	99	99	99	99	100	100	100	100
90.00	94	95	96	98	98	99	99	99	99	99	99	100	100	100	100	100
91.00	94	95	96	98	98	99	99	99	99	99	99	100	100	100	100	100
93.00	94	95	97	98	98	99	99	99	99	99	99	100	100	100	100	100
95.00	94	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
97.00	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.00	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.10	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.30	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.50	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.70	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.90	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.91	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.92	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.93	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.94	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.95	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.96	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.97	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.98	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
99.99	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100
100.00	95	96	97	98	98	99	99	99	99	99	99	100	100	100	100	100

Source: Gallen and Gambino, 1975.

It should be emphasized that the aim of the present study was to test, under field circumstances, a method for monitoring the performance of non-dental personnel in the detection of carious lesions, gingivitis and calculus. The personnel included in the study were of the types presently employed in Indonesia and therefore seemed appropriate for this initial test. However, it was recognized that there would be an ultimate need to put such a method to a broader test by introducing it to a pilot region where larger numbers of non-dental personnel could participate.

B. Population Sample

Four villages out of 17 in a readily accessible sub-district of the Tangerang Regency were chosen for the study on the basis of their convenient location. The four villages did not seem to be unusual. Indeed, the general socioeconomic features of all 17 villages in the sub-district were similar (Cipondoh Sub-district, 1983).

Six primary schools were then selected at random from these four villages. A table of random numbers was used for this purpose. From each school, one grade-six class (children aged approximately 12 years) was chosen. Where there was more than one such class in a school, the selection was made at random.

Class lists from the selected classes were then used to randomly select children for the study. Selected children were quickly screened by the candidate until a group of 100 was compiled with the following characteristics:

1. 70 children with a carious lesion, 40 of whom were regarded as needing emergency care.

2. 50 children with very obvious gingivitis.

3. 50 children with very obvious calculus.

These children were then scheduled for inclusion in the study.

C. Examination Procedure

Each of the 100 children was examined by the dentist, dental nurse, village cadre and teacher, respectively. The four examinations were performed on the same day at intervals of at least ten minutes. The sequence of examinations was random so that each examiner had an equal chance of performing either the first, second, third or fourth examination.

D. Dental Indices

For examination purposes, the mouth was divided into six sextants, as follows:

17--------14 13--------23 24--------27

47--------44 43--------33 34--------37

The following assessment methods were used:

(1) Caries

A value of 0 - 2 was assigned by the dental nurse, cadre and teacher in which: 0 = no carious lesion; 1 = a carious lesion, but not a need for emergency care; and 2 = a carious lesion requiring referral to the P.H.C. for emergency care. The dentist followed the same approach except that carious lesions not in need of emergency care were further sub-classified according to whether the enamel surface was regarded as intact. The scoring was: 0 = no carious lesion; 1 = an incipient lesion where

the enamel was intact; 2 = a carious lesion with broken enamel but not in need of emergency care; and 3 = a carious lesion requiring referral to the P.H.C. for emergency care.

2. Gingivitis

A value of '1' or '0' was assigned by the dental nurse, cadre and teacher according to whether gingivitis was readily demonstrable or not. By comparison, the dentist assigned a score of 0 - 3, in which: 0 = absence of gingivitis; 1 = mild gingivitis not associated with bleeding upon stimulation (gentle blunt probing of the sulcus); 2 = moderate gingivitis with associated bleeding following stimulation; and 3 = severe gingivitis with a tendency to profuse bleeding.

3. Calculus

The dental nurse, cadre and teacher assigned a value of '1' when calculus was readily apparent, as opposed to a value of '0' when it was not. By comparison, the dentist assigned a score of 0 -3, in which: 0 = no calculus present; 1 = supragingival calculus present, but not abundant; 2 = subgingival calculus present, but not abundant; and 3 = abundant supragingival and/or subgingival calculus present. Where there was both supragingival and subgingival calculus that was not abundant, a score of '2' was given. For each index, the sextant was assigned the worst score for any one tooth. These findings were recorded on forms designed to facilitate data processing (Appendix III.1).

Examination criteria were tailored to the operational standards of the Indonesian Dental Service. However, it was possible in this study for the dentist to use the Retention Index of Björby and Löe (1967) for calculus and the Gingival Index of Löe (1967).

Prior to the commencement of the study, informal standardization and calibration procedures were carried out by the candidate and one of her supervisors. Thus the candidate was reasonably experienced in the use of these indices prior to the commencement of the study.

E. Statistical Analysis

Initially, using the dentist as an absolute standard, the sensitivity, specificity and predictive value of examinations by the dental nurse, cadre and teacher were assessed (Figure III.1). This process was then repeated for the cadre and the teacher, this time using the dental nurse as the absolute standard.

Figure III.1: The Calculation of Sensitivity, Specificity and Predictive Value

	Disease Truly Present	Disease Truly Absent
Disease Found to be Present	a	b
Disease Found to be Absent	c	d

$$\text{Sensitivity} = \frac{a}{a + c} \times 100\%$$

$$\text{Specificity} = \frac{d}{b + d} \times 100\%$$

$$\text{Predictive Value -Positive} = \frac{a}{a + b} \times 100\%$$

$$\text{-Negative} = \frac{d}{c + d} \times 100\%$$

These analyses were based on whole-mouth scores, where each score constituted the highest value given to any one sextant. All

analyses were undertaken using a desk-top calculator, as would have to apply under present field circumstances in the Indonesian Dental Service.

III.2.4 Results and Comments

A. Caries - Dentist as the Standard

A.1 Caries Needing Emergency Care

The dentist found 38 children to need emergency care (Table III.4). Of these, the number found by the other personnel to need this care was:

(1) 35, as indicated by the nurse (sensitivity : 92%).

(2) 24, as indicated by the cadre (sensitivity : 63%).

(3) 21, as indicated by the teacher (sensitivity : 55%).

By comparison, of the 62 children not found to need emergency care by the dentist (Table III.4), there was a confirmatory assessment for:

(1) 62 from the nurse (specificity : 100%).

(2) 61 from the cadre (specificity : 98%).

(3) 62 from the teacher (specificity : 100%).

The predictive value of the findings of non-dentists, as relating to this group of selected children, is shown in Table III.5.

Table III.4. Caries Assessments by Dental Nurse, Cadre and Teacher According to Dentist's Assessments

Dentist Assessment*	Number of Children	Dental Nurse			Cadre			Teacher		
		Caries		No Caries	Caries		No Caries	Caries		No Caries
		Emerg.	Non-Emerg.		Emerg.	Non-Emerg.		Emerg.	Non-Emerg.	
3	38	35	3	0	24	13	1	21	17	0
2	27	0	27	0	1	19	7	0	19	8
1	5	0	2	3	0	1	4	0	1	4
1-3	70	35	32	3	25	33	12	21	37	12
0	30	0	5	25	0	7	23	0	2	28
Total	100	35	37	28	25	40	35	21	39	40

*.. 0 : No carious lesion.
1 : Carious lesion, enamel still intact.
2 : Carious lesion, needing no emergency care.
3 : Carious lesion, needing emergency care.

Table III.5: The Predictive Value of Emergency Case Findings of Non-Dentist Personnel

	Predictive Value Positive	Predictive Value Negative
Dental Nurse	100%	95%
Cadre	96%	81%
Teacher	100%	78%

These findings suggest that of the children deemed by the dentist to need emergency care, most would be considered to need this care by the dental nurse (92%). However, only about a half to two-thirds (55% -63%) would be referred for emergency care by the teacher and cadre. Although a degree of under-referral was apparent for these non-dental personnel, most of the cases indicated for referral were cases needing emergency care (predictive value of 96% and 100% for the cadre and teacher respectively). Thus these workers would appear to err on the side of specificity at the expense of sensitivity. Under normal operational circumstances, the dentist might have considered changing this balance. Children thought to require emergency care by the dentist, but not by the outreach workers, could well have been used as a basis for re-examination and counselling of these workers on the appropriate criteria for diagnosis and referral.

A.2 Any Caries

The dentist found 70 children to have a carious lesion (Table III.4). Of these, a confirmatory assessment was gained for:

(1) 67 from the nurse (sensitivity : 96%).

(2) 58 from the cadre (sensitivity : 83%).

(3) 58 from the teacher (sensitivity : 83%).

Thirty children were not found to have carious lesions by the dentist (Table III.4) and confirmation of this caries-free status was gained for:

(1) 25 from the nurse (specificity : 83%).

(2) 23 from the cadre (specificity : 77%).

(3) 28 from the teacher (specificity : 93%).

It was also found that sensitivity increased with the dentist's assessment of the severity of caries (Table III.6).

Table III.6: Sensitivity of Caries Diagnoses by Dental Nurse, Cadre and Teacher According to Dentist's Assessments of Caries Severity

Severity*	Number of Children	Dental Nurse	Cadre	Teacher
3	38	100%	97%	100%
2	27	100%	74%	70%
1	5	40%	20%	20%

*.. 3 : caries needing emergency care.

2 : caries not needing emergency care.

1 : initial caries, enamel intact.

It is notable that virtually all children with emergency needs were found to have a carious lesion by the outreach workers, and yet it was shown in the previous section that only 55% to 63% would have been referred to the clinic for this care. This suggests that attention should be given more to the criteria for referral than for diagnosis when counselling these outreach workers.

B. Caries - Dental Nurse as the Standard

B.1 Cases Needing Emergency Care

The nurse found 35 children to require emergency care (Table III.7).

Table III.7: Caries Assessments by the Cadre and Teacher According to Dental Nurse's Assessments

		Cadre			Teacher		
		Caries			Caries		
Dental Nurse Assessment	Number of Children	Emerg.	Non-Emerg.	No Caries	Emerg.	Non-Emerg.	No Caries
Emerg. Caries	35	22	12	1	19	16	0
Non-emerg. Caries	37	3	22	12	1	22	14
Total Caries	72	25	34	13	20	38	14
Caries free	28	0	6	22	1	1	26
Total	100	25	40	35	21	39	40

The number of these children in need of emergency care was considered to be:

(1) 22 by the cadre (sensitivity : 63%).

(2) 19 by the teacher (sensitivity : 54%).

Of the 65 children not found to need this care by the nurse (Table III.7), there was a confirmatory finding for:

(1) 62 from the cadre (specificity : 95%).

(2) 63 from the teacher (specificity : 97%).

Again, it would appear that these outreach workers tended to err on the side of specificity at the expense of sensitivity.

B.2 Any Caries

The nurse found carious lesions in 72 children (Table III.7). Of these, there was a confirmatory finding of caries for:

(1) 59 from the cadre (sensitivity : 82%).

(2) 58 from the teacher (sensitivity : 81%).

Twenty-eight children were found to be caries-free by the nurse (Table III.7). A confirmatory finding was obtained for:

(1) 22 by the cadre (specificity : 79%).

(2) 26 by the teacher (specificity : 93%).

It was noted that sensitivity increased with the nurse's assessment of the extent of progression of caries (Table III.8).

Again, it is evident that nearly all children with emergency needs (as judged by the nurse) were found to have a carious lesion by the outreach workers. Yet, as previously indicated, only about a half to two-thirds would have been referred for emergency care. This indicates a need for attention to the criteria used for referral.

Table III.8: Sensitivity of Caries Diagnoses by the Cadre and Teacher According to Dental Nurse's Assessments of Caries Severity

Severity	Number of Children	Cadre	Teacher
Needing Emerg. Care	35	97%	100%
Not Needing Emerg. Care	37	68%	62%

C. Gingivitis - Dentist as the Standard

Gingivitis was detected in 93 children by the dentist (Table III.9). Of these, the number found to have gingivitis was:

(1) 71, as indicated by the nurse (sensitivity : 76%).

(2) 28, as indicated by the cadre (sensitivity : 30%).

(3) 21, as indicated by the teacher (sensitivity : 23%).

Of the seven children not found to have gingivitis by the dentist (Table III.9), confirmatory evidence was obtained for:

(1) 7 by the nurse (specificity : 100%).

(2) 5 by the cadre (specificity : 71%).

(3) 7 by the teacher (specificity : 100%).

Table III.9: Gingivitis Assessments by Dental Nurse, Cadre and Teacher According to Dentist's Assessments

Dentist Assessment*	Number of Children	Dental Nurse Gingivitis Present	Dental Nurse Gingivitis Absent	Cadre Gingivitis Present	Cadre Gingivitis Absent	Teacher Gingivitis Present	Teacher Gingivitis Absent
3	13	13	0	8	5	9	4
2	34	30	4	10	24	4	30
1	46	28	18	10	36	8	38
1 - 3	93	71	22	28	65	21	72
0	7	0	7	2	5	0	7
Total	100	71	29	30	70	21	79

*.. 0 : no gingivitis.
1 : gingivitis not associated with bleeding on stimulation.
2 : gingivitis associated with bleeding on stimulation.
3 : gingivitis associated with a tendency to profuse bleeding.

Sensitivity tended to increase with the severity of gingivitis (as indicated by dentist), as is shown in Table III.10.

It was evident that when the dentist found gingivitis that was associated with profuse bleeding, the nurse invariably found gingivitis (Table III.10). Most cases were also found to have gingivitis by the outreach workers in this instance (62-69%). However, when the gingivitis was less severe, the level of confirmation was lower. In particular, the outreach workers only found gingivitis in a minority of these less severe cases. The predictive value of positive findings, as relating to this group of selected children, was high for the nurse, cadre and teacher (Table III.11). However, this was not so for the predictive value of negative findings.

Table III.10: Sensitivity of Gingivitis Assessments by Dental Nurse, Cadre and Teacher According to Dentist's Assessments of Gingivitis Severity

Severity*	Number of Children	Dental Nurse	Cadre	Teacher
3	13	100%	62%	69%
2	34	88%	29%	12%
1	46	61%	22%	17%

*.. 1 : gingivitis, no bleeding.
2 : gingivitis, bleeding on stimulation.
3 : gingivitis, with a tendency to profuse bleeding.

Table III.11: The Predictive Value of Gingivitis Findings of Non-Dentist Personnel

	Predictive Value Positive	Predictive Value Negative
Dental Nurse	100%	24%
Cadre	93%	7%
Teacher	100%	9%

Dental health education is unlikely to have serious side-effects if provided too liberally. Thus, it may be considered appropriate to favour sensitivity, even at the cost of some loss in specificity, when detecting gingivitis. In this test, sensitivity appears to be low. Therefore, under normal field circumstances, the dentist may well

have considered retraining outreach workers to increase the sensitivity of their examinations.

D. Gingivitis - Dental Nurse as the Standard

The dental nurse found gingivitis in 71 children (Table III.12). Of these children, the number confirmed as having gingivitis was as follows:

(1) 26 by the cadre (sensitivity : 37%).

(2) 19 by the teacher (sensitivity : 27%).

Table III.12: Gingivitis Assessments by the Cadre and Teacher According to Dental Nurse's Assessments

Dental Nurse Assessment	Total Number of Children	Cadre		Teacher	
		Gingivitis		Gingivitis	
		Present	Absent	Present	Absent
Ging. present	71	26	45	19	52
Ging. absent	29	4	25	2	27
Total	100	30	70	21	79

Of the 29 children not found to have gingivitis by the nurse (Table III.12), there was confirmation of this status for:

(1) 25 from the cadre (specificity : 86%).

(2) 27 from the teacher (specificity : 93%).

Again, it would appear that there is considerable scope for increasing sensitivity, even at the expense of some loss of specificity.

E. Calculus - Dentist as the Standard

Calculus was found in 86 children by the dentist (Table III.13). Of these children, the number assessed by the other examiners as having calculus was:

(1) 84, as indicated by the nurse (sensitivity : 98%).

(1) 78, as indicated by the cadre (sensitivity : 91%).

(1) 82, as indicated by the teacher (sensitivity : 95%).

Table III.13: Calculus Assessments by Dental Nurse, Cadre and Teacher According to Dentist's Assessments

Dentist Assessment*	Number of Children	Dental Nurse Calculus Present	Dental Nurse Calculus Absent	Cadre Calculus Present	Cadre Calculus Absent	Teacher Calculus Present	Teacher Calculus Absent
3	24	24	0	24	0	24	0
2	5	5	0	3	2	4	1
1	57	55	2	51	6	54	3
1 - 3	86	84	2	78	8	82	4
0	14	2	12	8	6	11	3
Total	100	86	14	86	14	93	7

* .. 0 = no calculus.
1 = non-abundant supragingival calculus.
2 = non-abundant subgingival calculus.
3 = abundant calculus (supragingival and/or subgingival).

As for the other conditions, sensitivity tended to increase with the extent of the condition (Table III.14).

Table III.14: Sensitivity of Calculus Assessments by Dental Nurse, Cadre and Teacher According to the Dentist's Assessments of Calculus Level

Calculus Level*	Number of Children	Dental Nurse	Cadre	Teacher
3	24	100%	100%	100%
2	5	100%	60%	80%
1	57	96%	89%	95%

*.. 1 = non-abundant supragingival calculus.
2 = non-abundant subgingival calculus.
3 = abundant calculus (supragingival and/or subgingival).

Of the 14 children found not to have calculus by the dentist (Table III.13), confirmatory evidence of a calculus-free status was obtained for:

(1) 12 from the nurse (specificity : 86%).

(2) 6 from the cadre (specificity : 43%).

(3) 3 from the teacher (specificity : 21%).

The predictive values of the examinations of the non-dentist personnel, as applying to this group of selected children, is provided in Table III.15.

Table III.15: The Predictive Value of Calculus Findings of Non-Dentist Personnel

	Predictive Value Positive	Predictive Value Negative
Dental Nurse	98%	86%
Cadre	91%	43%
Teacher	88%	43%

F. Calculus - Dental Nurse as the Standard

Calculus was detected in 86 children by the dental nurse (Table III.16). The number of these children assessed as having calculus was:

(1) 78, as indicated by the cadre (sensitivity : 91%).

(2) 81, as indicated by the teacher (sensitivity : 94%).

Of the 14 children not found to have calculus by the nurse, the number considered to be calculus-free was:

(1) 6 by the cadre (specificity : 43%).

(2) 2 by the teacher (specificity : 14%).

As indicated previously, cadre and teacher examinations had a high sensitivity but a low specificity. Therefore, it is evident that supervisory staff may have wished to increase specificity, even at the cost of some loss in sensitivity.

Table III.16: Calculus Assessments by Cadre and Teacher According to Dental Nurse's Assessments

Dental Nurse Assessment	Number of Children	Cadre Calculus Present	Cadre Calculus Absent	Teacher Calculus Present	Teacher Calculus Absent
Calculus present	86	78	8	81	5
Calculus absent	14	8	6	12	2
Total	100	86	14	93	7

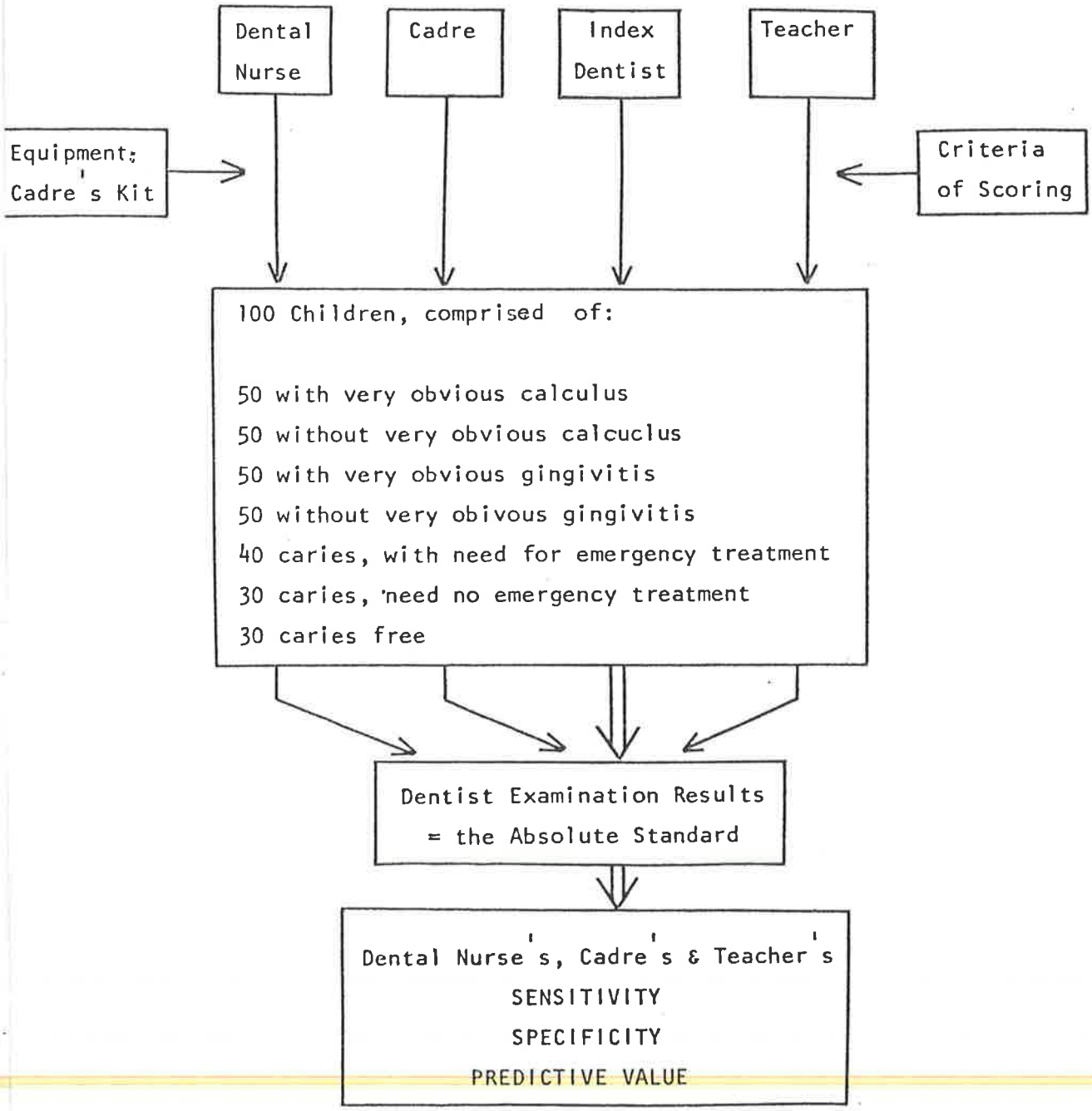
III.2.5 Discussion

It would appear from the pre-test that this approach to monitoring could yield useful information for the appraisal and control of the quality of examinations in the Indonesian dental system. The dentists could readily screen the population on a periodic basis to obtain samples of children for repeat examinations by nurses and selected cadres and teachers. All nurses could be assessed in this way by their supervisory dentists, as could samples of cadres and teachers (Figure III.2). The remaining cadres and teachers could then be evaluated in similar periodic assessments undertaken independently of the dentists by dental nurses.

A sample of 100 children was drawn in this study to give an indication of the performance of personnel at examination and referral (Figure III.2). The composition by dental status was predetermined to give a reasonable distribution of conditions for estimating sensitivity and specificity. Since predictive value is affected by prevalence, the predictive values calculated in this study are artificial, and have been

Figure III.2

Evaluation of the Accuracy of Caries, Calculus and Gingivitis Detection by Dental Nurse, Teacher and Cadre



calculated only to demonstrate technique. However, it would be possible to estimate the predictive values applying under normal operational circumstances by taking account of prevalence at the community level and the information on sensitivity and specificity gained in these types of assessments.

The size of the sample (100 children) was the maximum thought to be potentially feasible under present field conditions in Indonesia. The equipment used was that normally provided to cadres (Cadre's Kit) and teachers. The dichotomous method of classifying patients' dental status was a feasible approach to use. Also, it was consistent with the approach recommended in the World Health Organization's manual entitled 'Oral Health Survey Basic Methods' (WHO, 1977).

Although assessments of sextants would yield more detailed information than those based on whole mouths, the additional utility of this broader information would be questionable. Under present field conditions, data would need to be sorted and analysed without the assistance of a computer. The processing of all sextant scores is likely to prove unmanageable under these circumstances. However, it would be practical to use whole-mouth data for this purpose, as in this study, and then review sextant scores only for those children where examination findings of the non-dental personnel were suspect. In such instances, sextant scores may indicate areas of the mouth where discrepancies tend most to occur. Alternatively, it may be preferable only to record whole-mouth assessments in the first place. Where divergences between examiners were found to be unacceptably large, specific children could be re-examined and used as a basis for discussion and counselling. By concentrating on whole mouths, the data recording form (Appendix III.2)

could be simplified considerably and a simple proforma could be used for calculation purposes (Appendix III.3).

Based on the present study, it would appear that the time required for manual data processing and analysis would be about six hours. This could be undertaken by the nurse. Advantage would be taken of those clinical times when patients fail to attend.

It has been the aim of the present study to develop and test a method for monitoring that would be feasible under normal field circumstances. It is recognized that point estimates of sensitivity, specificity and predictive value have been used as indicators of performance, without reference to confidence intervals. Often statistically more precise estimates may have been desirable, but this would have required larger samples of children. The intention was to limit the number of examinations performed by each examiner to around 100. A larger number, in the candidate's opinion, would be difficult to justify under normal field conditions, given competing demands on staff time.

The extent of agreement/disagreement between examiners in the present study has no particular relevance. It should be possible in the normal field circumstances for dentists to achieve a greater measure of consistency through the training of outreach personnel in the application of diagnostic and referral criteria, and by periodic checks of performance using the methods described.

III.3 STUDY TWO: The Removal of Calculus

III.3.1 Introduction

It has been noted previously in this thesis that since the dentist is ultimately responsible for the quality of care performed in a Public Health Centre in Indonesia, as well as for the attention provided in villages and schools in the clinic catchment area, there needs to be a monitoring system that enables the dentist to assess whether operational performance is satisfactory.

In this section of the thesis, a system for monitoring the performance of cadres and other non-dental personnel in the removal of calculus and provision of accompanying oral hygiene instruction is described.

III.3.2 Review of the Literature

It is not the purpose of this thesis to review the evidence for an adverse effect of dental calculus on periodontal health, although some publications on this subject have been discussed briefly in Appendix I.1. A review of methods for assessing oral hygiene and periodontal status is now provided, however, to serve as a background to this study.

Various methods for assessing oral hygiene and periodontal status have been developed to meet clinical and research requirements. These methods have often been designed to take account of the aetiological concepts prevailing at the time. Therefore, as these concepts have changed, modifications have been introduced to the assessment methods.

In 1947, one of the earliest attempts was made to quantify periodontal health when Schour and Massler introduced their P.M.A. index

(Papillary, Marginal, Attached gingivae). This index was subsequently shown to have deficiencies in validity and reliability (Massler, M., 1967; Hazen, S., 1974).

Russell's Periodontal Index (P.I.) and Ramfjord's Periodontal Disease Index (P.D.I.) were developed in the late 1950's. Both scored 'reversible' and 'irreversible' periodontal conditions on one grading scale. In order to increase the utility of these indices, simplified scoring criteria were introduced for Russell's P.I., whereas Ramfjord's P.D.I. was restricted to selected teeth (Russell, A., 1956; Ramfjord, S., 1959). Although these indices have been used widely, with beneficial results, many authorities now feel that they have substantial limitations. These relate to the grading of severity, the scope for objective measures with the criteria recommended, the customary use of mean values rather than percentage distributions of individual values, and the practicality of these indices in many field studies. (Löe, H., 1967; Bellini, H., 1974; Barmes, D., 1976; Davies, G., and Barmes, D., 1976; Burt, B., 1983b). It has been noted that the gingival criteria for these indices tend to concentrate on the horizontal extent of visible inflammation around the tooth, rather than the degree of pathological change (Löe, H., 1967).

The Gingival Index (G.I.) was introduced by Löe and Sillnes in 1967 as a means of quantifying the extent of gingival pathological change around the circumference of the tooth (Löe, H., 1967). This index was considered to be more sensitive than the other gingival indices available at the time. Although some difficulties were experienced with examiner consistency, the G.I. has proved to be a reliable measure when used by skilled examiners (Burt, B., 1983b). The G.I. may be based on all erupted

teeth or be limited to selected teeth, or even selected surfaces of teeth (Löe, H., 1967).

The Sulcus Bleeding Index was introduced in 1971 and was based on the rationale that bleeding from the gingival sulcus would be one of the earliest clinical signs of gingivitis (Mühleman, H., and Son, S., 1971). The counting of bleeding sites was considered to be a simple, rapid and objective screening method. However, the complex severity grading associated with this index tended to increase the degree of inconsistency of scoring (Burt, B., 1983b). Furthermore, the clinical implications of the resulting index scores were difficult to interpret.

Periodontal indices have often been used conjointly with indices that measure such aetiologically related factors as plaque, calculus and conditions that encourage the retention of plaque. The need for these ancillary indices was appreciated when the correlation between oral hygiene status and periodontal health became obvious (Burt, B., 1983b).

In 1960, the Oral Hygiene Index (O.H.I.) was introduced, before being simplified and restricted to selected surfaces as the Oral Hygiene Index Simplified, or O.H.I.S., in 1964 (Greene, J., and Vermillion, J., 1960, 1964). These indices scored the quantity of both soft and hard deposits according to their extension over tooth surfaces. By comparison, the Plaque Index (Pl.I.), developed by Löe and Sillness, quantified the thickness of the soft deposit at the gingival margin, rather than its coronal extension (Löe, H., 1967). Löe and other researchers had recognized the limitations of pre-existing indices of soft deposits in studies of experimental gingivitis in man (Löe, H. et al., 1965). They had noted that the localization of the deposits near the gingivae appeared to be more important than the absolute

quantity. The newly developed Pl.I. was frequently used in conjunction with the G.I.

The Retention Index System was introduced by Björby and Löe in 1967. The criteria for the Retention index were designed to assess tooth conditions which would enhance the accumulation of plaque. These conditions included carious lesions, calculus and imperfect gingival margins of dental restorations. Both the Pl.I. and the Retention Index System were sometimes limited to selected teeth when screening large populations, whereas in rigorous clinical studies it was frequent for all teeth to be included (Löe, H., 1967).

Unlike Russell's P.I. and Ramfjord's P.D.I., the indices developed by Löe (the G.I. and Pl.I.) and Björby's Retention Index System were explicitly designed to measure 'reversible' periodontal conditions only (Löe, H., 1967). They were considered to be suitable for screening gingival conditions as well as for assessing the effectiveness of treatment and oral hygiene instruction in both children and adults.

It is evident that the choice of an index should be governed by the aims of an investigation and the likely feasibility and acceptability of alternative indices in the specific research setting (W.H.O., 1978). However, certain fundamental requirements need to be met by all indices. The criteria for an 'ideal' index have been described by Russell (Russell, A., 1969). It appears that no periodontal index can be regarded as totally ideal. For example, all entail a measure of subjectivity that can lead to examiner variability.

The Community Periodontal Index of Treatment Needs (CPITN) was recently introduced to simply and objectively assess the periodontal treatment needs of population groups (Ainamo, J. et al., 1982). The index was designed so that much of the subjectivity entailed in previous indices were removed and clinical assessments were simplified, by the use of the following principles:

(1) Sextant approach, whereby only one recording is made for each sextant, based on the worst score of specified index teeth.

(2) Dichotomous criteria for the absence or presence of lack periodontal disease indicator.

(3) Prescription of treatment needs, based on the findings of disease indicators and modelled on the Periodontal Treatment Need System (Johansen, J. et al., 1973).

The CPITN appears to fulfil the need for a simple, reliable and rapid assessment of periodontal treatment needs for population surveys and appears to have gained wide acceptance as the preferred epidimiological tool (Ainamo, J. 1984, Ainamo, J. et al., 1984). Despite its advantages, the CPITN neither explicitly measures effectiveness of periodontal intervention or treatment (Ainamo, J., 1982). In a study where the effectiveness of periodontal treatments are being rigorously examined, a more sensitive index may be required.

The present study was directed at assessing the effectiveness of oral hygiene instruction and calculus removal by various types of personnel. After careful consideration of the study objectives, and the field setting

where the study would take place, the indices chosen were Löe's Gingival Index, Silness and Löe's Plaque Index, and Björby and Löe's Retention Index System (Löe, H., 1967).

III.3.3 Materials and Methods

A. Research Design

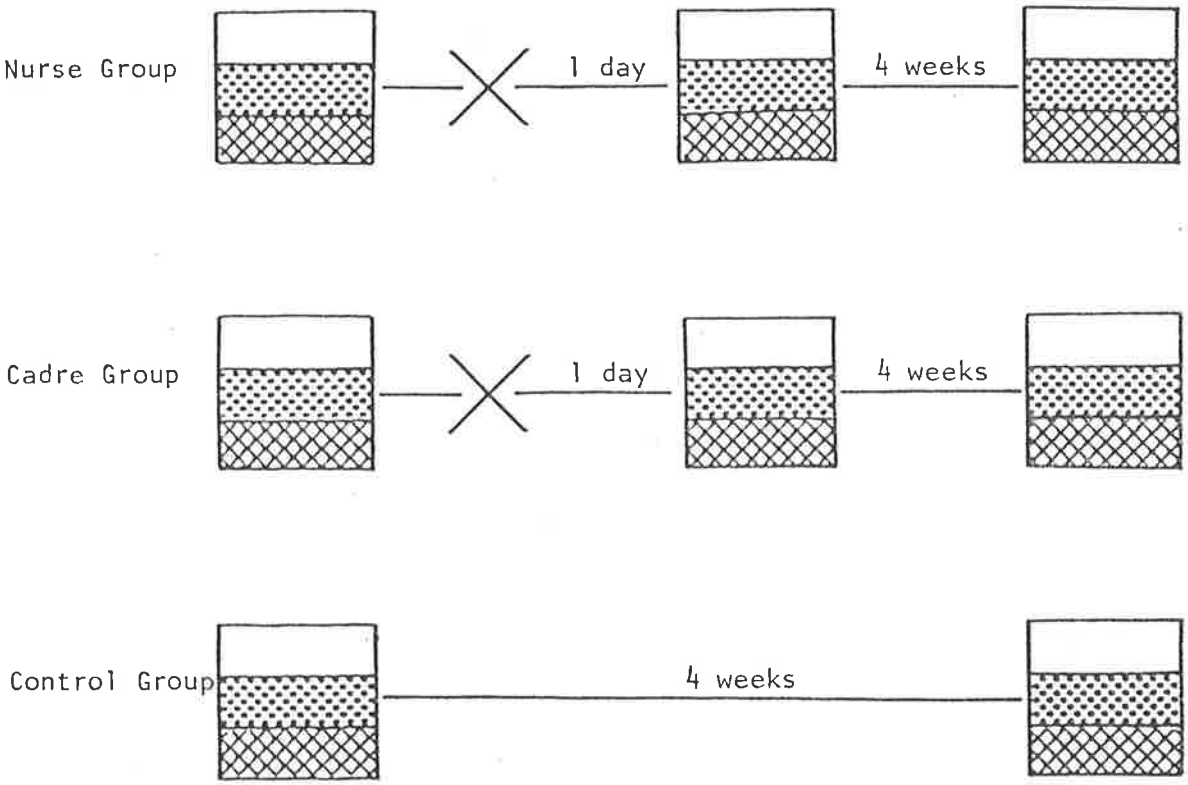
In general, the approach taken was first to select, through screening examinations, 150 children with calculus. These were divided into three comparable groups. One group received treatment (calculus removal and oral hygiene instruction) from a dental nurse, another was similarly treated by a cadre, and the third group served as a control.

The candidate, acting as the dentist, examined the pre-selected 150 children to assess their calculus, oral debris and gingivitis levels. These examinations were performed 'blind' (without examiner knowledge of the groups to which individual children belonged). Calculus levels of the treated children were then re-assessed 'blind' immediately after treatment. Follow-up examinations of all 150 children, similar to those at the baseline, were undertaken one month post-treatment. These were also performed 'blind' (Figure III.3).

Results were analysed to indicate the level of oral health of the children treated by the cadre and nurse respectively relative to that of the controls. The validity of findings based on very simple analyses was assessed by comparing these findings with those gained from more complex multivariate analyses. The purpose was to test the utility of simple

Figure III.3

Assessment of the Effectiveness of Calculus Removal and the Accompanying Oral Hygiene Instructions



analyses of the type that should be feasible under normal field circumstances in Indonesia. Methodological aspects are now described in detail.

B. Population Sample

A total of 150 children with calculus was first compiled using brief examinations of students in the fifth and sixth grades of four schools in the Tangerang Regency. Seventy-four of the children were males and 76 were females. The age distribution was as follows:

(1) 10 years : 1

(2) 11 years : 35

(3) 12 years : 60

(4) 13 years or more : 54

The children were allocated sequentially into three groups. The allocation was undertaken separately for each school using school class lists. The three groups included 51, 50 and 49 children respectively. The first group (51) was selected at random as the control (i.e., not to be exposed to calculus removal or oral hygiene instruction). The second (50) and third (49) groups were selected at random to receive oral hygiene instruction and calculus removed by a dental nurse and cadre respectively.

The dental nurse participating in this study was provided by the University of Indonesia, whereas the cadre came from the Tangerang Regency. Neither appeared to be exceptional examples of their respective categories of worker.

C. Examinations

The candidate examined the 150 children 'blind' in class-list

order. It has been indicated that the indices used were the Retention Index System of Bjørby and Löe for calculus, the Plaque Index of Sillness and Löe, and Löe's Gingival Index for gingival status (Löe, H., 1967). Interpretation of the scores was as follows:

(1) Calculus - 0 : no calculus present.
1 : supragingival calculus.
2 : subgingival calculus (with or without supragingival calculus).
3 : an abundance of supragingival and/or subgingival calculus.

(2) Debris - 0 : no plaque adjacent to the gingival tissues.
1 : tooth appears clean, but a film of plaque catches on the probe when probing the tooth adjacent to the gingival tissues.
2 : moderate levels of plaque accumulation visible adjacent to the gingival tissues.
3 : an abundance of plaque at the crevice, gingival margin and/or adjacent tooth surface.

(3) Gingivitis - 0 : absence of gingivitis.
1 : mild gingivitis not associated with bleeding upon stimulation (gentle blunt probing of the sulcus).

2 : moderate gingivitis associated with bleeding following stimulation.

3 : severe gingivitis, with a tendency to profuse bleeding.

For examination purposes, the mouth was divided into the following sextants :

17--------14	13--------23	24--------27
47--------44	43--------33	34--------37

Each sextant was assigned a score which constituted the highest value for any one tooth. Sextant scores were totalled to give a mouth score from 0 to 18. Since all children had one or more teeth in each sextant, these totals were used for convenience as the oral scores (i.e., they were not converted to a mean sextant score by dividing by six, as is commonly the practice).

Examinations of all 150 children were undertaken prior to exposure of test children to oral hygiene instruction and scaling (baseline examinations) and one month after exposure. In addition, calculus assessments were made for groups two (nurse treated) and three (cadre treated) immediately following exposure.

Prior to the commencement of the study, informal standardization and calibration procedures were carried out by the candidate and one of her supervisors. Thus, the candidate was reasonably experienced in the use of these indices prior to the commencement of the study. While it proved to be impractical to undertake duplicate examinations to assess examiner variability during the actual field study,

the design of the study was such that systematic bias would appear to have been unlikely.

D. Calculus Removal and Oral Hygiene Instruction

This was undertaken under normal field conditions, using the portable equipment and protocols specified for this purpose by the Indonesian Dental Service. The study took place in the grounds of the participating schools. The instruments used were those included in cadre's kit, as described in the first study.

E. Statistical Analyses

Using the final examination results only, the percentages of treated children with 'high' calculus, debris and gingivitis scores were calculated. Comparisons with respective control percentages indicated the extent of benefit derived from hygiene care by the nurse and cadre respectively. For this purpose, 'high' was defined arbitrarily as a score of: (1) 3 - 18 for calculus; (2) 3 - 18 for debris; and (3) 4 - 18 for gingivitis.

As a slight refinement, simple Chi-square tests were performed (using the Yates' correction) to test the statistical significance of the differences observed (Armitage, P., 1971). It was felt that some field dentists would gain sufficient statistical expertise to perform these simple tests under normal field conditions.

By dividing the percentages of children with 'high' scores in each treatment group by the respective percentages for the control group, it was possible to obtain point estimates of the relative risks of having 'high' scores in treatment as opposed to control groups (Lilienfeld, A., and Lilienfeld, D., 1980; Armitage, P., 1971).

B. Further Analyses

Three multivariate logistic analyses were performed on the three sets of data (calculus, debris, and gingivitis data respectively) to further examine the association of outcome scores with group affiliation. These were undertaken on an IBM Computer using the EPILOG Statistical Package (Epicenter, California, 1984).

The outcome variables were the same as for the simple analyses, with each being classified as 'high' or 'low'. To control for any initial imbalances between the three groups, the following baseline values were entered into the analyses:

(1) Age (years).

(2) Sex (M = 1, F = 2).

(3) Schools (three dummy variables).

(4) Calculus (0 - 18).

(5) Debris (0 - 18).

(6) Gingivitis (0 - 18).

The final statistical models included those variables that proved to be significant (p 0.10). In addition, two dummy variables were included in the final models to denote the membership of group two (nurse treated) and group three (cadre treated) respectively. The reference category in this instance was the control group.

Regression coefficients ($\pm$ standard errors) indicated whether membership of group two or three was associated with the outcome scores. Relative risks of having 'bad' scores in these treatment groups (as compared with controls) were calculated from the model using the standard techniques shown in the 'Results' section. These relative risks were compared with the corresponding ones derived from the simple analyses.

III.3.4 Results and Comments

A. Calculus

1. Simple Analysis

The percentage of controls with a 'high' calculus score at the final examination was 78.4%, compared with 12.0% for the nurse-treated group and 36.7% for the cadre-treated group (Table III.17). This gave a relative risk of having a 'high' calculus score of 0.15 and 0.47 for the nurse-treated and cadre-treated children respectively.

Table III.17: The Relative Risk of a 'High' Calculus Score One Month After Care

Group	n	Children with a 'High' Calculus Score	Relative Risk*
Control	51	40	
Nurse-treated	50	6	0.15 ($X^2_{(1)} = 42.3$; $p<0.001$)
Cadre-treated	49	18	0.47 ($X^2_{(1)} = 16.2$; $p<0.001$)

* Control = reference category.

2. Multivariate Analysis

The regression coefficients ($\pm$ standard errors) for predictor variables are presented in Table III.18. The results indicate that being treated either by the dental nurse or cadre was negatively associated with a 'high' calculus score, after adjusting for baseline differences in calculus levels between the groups.

Table III.18: Association of Predictor Variables with 'High' Calculus scores.

Predictor Variable	Regression Coefficient (± S.E.)
Baseline Calculus Score	0.548 ± 0.103 (p 0.001)
Nurse-treated	-4.484 ± 0.760 (p 0.001)
Cadre-treated	-2.093 ± 0.548 (p 0.001)
Constant	-0.857 ± 0.505

For the nurse-treated group, the relative risk of having a 'high' outcome score, when compared with controls, can be calculated from the model as follows:

$$\text{Relative risk} = \frac{\text{probability of having a 'high' score after being treated}}{\text{probability of having a 'high' score when not treated}}$$

Assuming that the nurse-treated group were to have the overall mean baseline calculus score of 4.640 at the baseline, then the relative risk (R.R.) can be calculated from the model as follows:

$$\text{R.R.} = \frac{e^{-0.857 - 4.484 + (0.548 \times 4.640)}}{1+e^{-0.857 - 4.484 + (0.548 \times 4.640)}} \div \frac{e^{-0.857 + (0.548 \times 4.640)}}{1+e^{-0.857 + (0.548 \times 4.640)}}$$

This gives a relative risk for the nurse-treated group of 0.07, which is a similar finding to the relative risk of 0.15 obtained from the simple analysis (Table III.17).

Using the same approach for the cadre-treated group, the corresponding relative risk can be calculated as follows:

$$R.R.= \frac{e^{-0.857 - 2.093 + (0.548 \times 4.640)}}{1+e^{-0.857 - 2.093 + (0.548 \times 4.640)}} \quad \frac{e^{-0.857 + (0.548 \times 4.640)}}{1+e^{-0.857 + (0.548 \times 4.640)}}$$

Notably, the resulting value, 0.47, is the same as that calculated in the simple analysis (Table III.17).

3. Comments

It is evident that both the simple and more complex analyses provided equivalent relative risks of having a 'high' calculus score in the treated groups when compared with the controls. It is relevant to note in this regard that the method of allocating children to the comparison groups led to only very small differences in baseline calculus scores between test and control groups that were not statistically significant ($p = 0.18$; Kruskal-Wallis One-way ANOVA, Chilton, N., 1980).

B. Debris

1. Simple Analysis

The percentage of controls with a 'high' debris score at the final examination was 62.7%, compared with 34.0% for the nurse-treated group and 53.1% for the cadre-treated group (Table III.19). This gave a relative risk of having a high debris score of 0.54 for the nurse-treated children and 0.85 for the cadre-treated group.

Table III.19: The Relative Risk of a 'High' Debris Score One Month After Care

Group	n	Children with a 'High' Debris Score	Relative Risk*
Control	51	32	
Nurse-treated	50	17	0.54 ($X^2_{(1)}$ = 7.2; p 0.01)
Cadre-treated	49	26	0.85 ($X^2_{(1)}$ =0.6; p 0.05)

* Control = reference category.

2. Multivariate Analysis

The regression coefficients (± standard errors) for predictor variables are presented in Table III.20. As in the simple analysis, a statistically significant negative association was found between the probability of having a 'high' debris score and being treated by the nurse. Both approaches also suggested a possible negative association for treatment by the cadre, but the findings were not statistically significant at the five per cent level (Tables III.19 and III.20).

Table III.20: Association of Predictor Variables with 'High' Debris Scores

Predictor Variable	Regression Coefficient (± S.E.)
Baseline Debris Score	0.284 ± 0.069 (p 0.001)
Nurse-treated	-1.207 ± 0.446 (p = 0.007)
Cadre-treated	-0.607 ± 0.440 (p = 0.168)
Constant	-0.820 ± 0.433

From the above model, the relative risk of having a 'high' debris score can be calculated for each treated group, using the mathematical approach shown in the previous section. If both treated groups were to have the overall mean baseline debris score of 5.053, the relative risk of having a 'high' debris score at the final examination would be 0.55 and 0.77 for the nurse-treated group and cadre-treated group respectively. These are similar to the corresponding relative risks calculated in the simple analysis (Table III.19).

3. Comments

It is again apparent that both the simple and more complex analyses gave very similar findings. In addition, it is evident that the method of allocation of children to the three groups led to only very small differences in baseline debris scores between the test and control groups that were not statistically significant ($p = 0.17$; Kruskal-Wallis One-way ANOVA, Chilton, N., 1980).

C. Gingivitis

1. Simple Analysis

The percentage of controls with a 'high' gingivitis score at the final examination was 72.5%, compared with 54.0% for the nurse-treated group and 59.2% for the cadre-treated group. This gave a relative risk of having a 'high' gingivitis score of 0.74 for the nurse-treated children and 0.82 for the cadre-treated children (Table III.21).

Table III.21: The Relative Risk of a 'High' Gingivitis Score One Month After Care

Group	n	Children with a 'High' Ging. Score	Relative Risk*
Control	51	37	
Nurse-treated	50	27	0.74 ($X^2_{(1)}$ = 3.0; p 0.05)
Cadre-treated	49	29	0.82 ($X^2_{(1)}$ = 1.4; p 0.05)

* Control = reference category.

2. Multivariate Analysis

The regression coefficients (± standard errors) for the predictor variables are presented in Table III.22.

Table III.22: Association of Predictor Variables with 'High' Gingivitis Scores

Predictor Variable	Regression Coefficient (± S.E.)
Baseline Debris Score	0.178 ± 0.086 (p = 0.038)
Baseline Gingivitis Score	0.521 ± 0.125 (p < 0.001)
Nurse-treated	-0.777 ± 0.483 (p = 0.108)
Cadre-treated	-0.575 ± 0.512 (p = 0.262)
Constant	-3.337 ± 0.8667

As suggested by the simple analysis, there was a possible negative association for treatment by the nurse and cadre, but the findings were not statistically significant at the five per cent level (Tables III.21 and III.22).

If the overall mean baseline debris score of 5.053 and corresponding mean gingivitis score of 7.067 were to apply to both treated groups, the relative risks of having a 'high' gingivitis score in the final examination can be calculated from the model as 0.79 for the nurse treated children and 0.85 for the cadre-treated children. These findings are similar to those obtained from the simple analysis (Table III.21).

3. Comments

It is evident once again that both the simple and more complex analyses yielded similar findings. It is also evident that the method of allocating children to the three comparison groups was associated with only very small differences in baseline gingivitis scores that were not statistically significant at the five per cent level ($p = 0.63$, Kruskal-Wallis One-Way ANOVA, Chilton, N., 1980).

D. Supplementary Background Data

The simple analyses undertaken in this study involved the calculation of percentages of children with prescribed 'high' scores in the final examination only. This would appear to be a practical approach for normal field situations. It also appears to be reasonably valid.

More detailed background information is provided in Table III.23. Due to the ordinal scales and skewed character of the data, it is doubtful whether conventional 't-tests' should be applied. Nonetheless, a simple perusal of the mean scores provides no indication of a reduction in calculus scores between baseline and final examinations for the controls. By comparison, pronounced reductions are evident for both treated groups.

Reductions between the baseline and final examination scores tended to be less pronounced for debris and gingivitis scores than for

calculus among the treated children. The smallest reductions applied to the control group. The tendency for any reduction to have occurred in the control group may reflect a carry-over of health-education effects from the treated groups, plus an increased interest in dental health resulting from mere participation in the study. It is also possible that examiner variability may have contributed to this finding.

Table III.23: Mean Calculus, Debris and Gingivitis Scores* at Baseline and Subsequently

Oral Condition	Control Group	Nurse-treated Group	Cadre-treated Group	Total
Calculus				
Baseline	4.941 ± 0.399	4.820 ± 0.370	4.143 ± 0.421	4.640 ± 0.229
Immed. after Care	-	0.540 ± 0.132	1.490 ± 0.251	-
1 Month after Care	5.098 ± 0.399 (+3%)	1.100 ± 0.194 (-77%)	2.020 ± 0.263 (-51%)	2.760 ± 0.222 (-41%)
Debris				
Baseline	5.000 ± 0.383	4.540 ± 0.429	5.633 ± 0.483	5.053 ± 0.251
1 Month after Care	3.843 ± 0.396 (-23%)	2.460 ± 0.340 (-46%)	3.285 ± 0.412 (-42%)	3.200 ± 0.225 (-37%)
Gingivitis				
Baseline	7.373 ± 0.327	6.860 ± 0.317	6.959 ± 0.426	7.067 ± 0.206
1 Month after Care	6.078 ± 0.451 (-18%)	4.280 ± 0.433 (-38%)	4.694 ± 0.456 (-33%)	5.027 ± 0.264 (-29%)

* Mean value ± Standard error.

.. Percentage difference from baseline in brackets.

III.3.5 Discussion

The present study indicates that it should be possible for a dentist to periodically evaluate the performance of non-dentist personnel using the monitoring system and simple analyses described. The total number of children included (150) was selected as the maximum that would seem practical, given competing demands on the dentist's time. It was realized, however, that the larger the sample size, the more statistically precise would be the resulting relative-risk estimates (Lilienfeld, A., and Lilienfeld, D., 1980).

While the 'p' value alone would indicate the presence or absence of an association, this was considered to be a less useful parameter in the present study than point estimates of the relative risks of unfavourable outcomes according to treatment exposure. It should be noted in this context that relative risks provided a direct estimate of the actual effect of care.

The clinical measurements used to assess the effects of the hygiene care were found to be practical under normal field conditions. This is an important aspect that is additional to the other fundamental criteria of validity, reliability, sensitivity, acceptability and amenability to statistical analysis (Russell, A., 1969). The examinations were carried out with the aid of very basic hand instruments and in a minimum amount of time. High acceptability was gained from the study population.

Index scores were recorded on a precoded form designed for ready manual and computer-based assessments (Appendix III.4). Clinical assessments and data recording were undertaken without examiner knowledge of the groups to which individual subjects belonged. To further

reduce the potential for bias, study subjects were not told of their involvement in a special study (Campbell, D., and Stanley, J., 1966). Clearly, this approach would be facilitated in a Service where quality assessments were a normal part of operations.

In the present investigation, a period of one month was allowed to elapse between the baseline and final examinations. This was considered to be a sufficient time for gingival healing to take place and for any improvements in oral habits to show advances in oral health (Meitner, S., 1979).

It would seem that day-to-day monitoring in the Indonesian Dental Service might be limited to checking samples of treated children to ensure that remaining calculus levels were acceptably low. Periodically, possibly every two years, the approach used in this study might be applied for selected non-dental personnel to more rigorously assess the benefits of their care. Comparisons with controls and a nurse-treated group would facilitate a judgement of the extent of benefit gained.

It may be that the dental nurses should be held responsible for the day-to-day checking of samples of patients treated by non-dental personnel, with the dentist assuming responsibility for more elaborate periodic reviews on a two-yearly basis.

IV. GENERAL DISCUSSION

Systems for monitoring the quality of dental care provided by non-dental personnel in Indonesia (village cadres and school teachers) have been described and tested. The issue of quality has assumed increased significance in Indonesia with the introduction of non-dental personnel as care providers. Increasingly, emphasis has been placed on quality appraisal in dental services in other parts of the world also, particularly where unconventional types of dental personnel have been introduced (P.A.C., 1980; Burt, B., 1983; Elderton, R., 1974). Indeed, quality appraisal was recently cited as the most important contemporary issue in health service delivery (Donabedian, A., 1980; Baker, F. and McPhee, C., 1979).

In this thesis, emphasis has been placed on assessing the diagnostic and treatment outcomes of services provided by non-dental personnel. This approach had been proposed earlier by Wiliamson (1971). According to Donabedian (1980), there are two other aspects that should be considered, namely: (1) evaluation of the 'process' of care to determine whether 'good care' is being provided; and (2) assessment of 'structure', which refers to the available resources and the physical and organizational environment in which the health programme operates. However, it was further suggested by Donabedian that an 'outcome' evaluation would normally be the more comprehensive since 'outcome' should also reflect aspects of 'process' and 'structure' (Donabedian, A., 1980). Thus an 'outcome' approach was chosen in the present research programme as a starting point for monitoring Indonesian dental services.

When assessing the value of the monitoring models described in Study-one and Study-two, validity, cost, timeliness, feasibility,

acceptability and effectiveness should be considered. Important criteria for evaluating the validity of quality assessment models should include the appropriateness of the measurements used and the accuracy of the data collection and analysis (Donabedian, A., 1980). In addition, methods of selecting subjects, and the potential biasing effects of the aspects of history, maturation, testing, instrumentation and study subject attrition should also be taken into account (Campbell, D., and Stanley, J., 1966).

The appropriateness of using sensitivity, specificity and predictive values as criteria for assessing the diagnostic value of a test or examination has been recognized by many researchers (Thorner, R., 1967; Grant, J., 1974; Hart, G., 1980; Galen, R., and Gambino, S., 1975). It would appear from Study-one that assessments of the diagnostic performance of different types of personnel could be performed in an objective, systematic and precise quantitative manner using these criteria. Likewise, the indices used in Study-two were well accepted measures for assessing effects of hygiene care (Löe, H., 1967). The reduction of outcome scores to dichotomous scales facilitated the application of simple statistical analyses of a type that should be feasible for field personnel. This approach, together with the use of sextants, is consistent with protocols recommended by the World Health Organization in its publication 'Oral Health Surveys -Basic Methods' (W.H.O., 1977), and appeared adequate to achieve study objectives.

In the model for evaluating hygiene care, a control group was included and children were assigned sequentially from class lists to comparison groups. A strict random approach was not favoured for practical reasons. Nonetheless, in the research design employed, other sources of potential bias, such as history, maturation, testing, and

instrumentation, should have been controlled (Campbell, D., and Stanley, J., 1966). As a result of the short duration of the study (one month), there was no attrition of the study group and therefore not the potential for bias from this factor. Thus the model developed for monitoring the effectiveness of hygiene care seemed to be valid and appropriate.

In both models, forms were designed so as to minimize the task of collecting data in the field. Browskowsky (1979) has stated a preference for forms that are simple and acceptable to those who must complete them, rather than for forms designed primarily for efficiency in data processing. It was evident during the field testing reported in this thesis that the precoded forms were practical both for data recording and manual processing. Also, data analyses using a very simple statistical method were found to be valid when compared with a more complex statistical treatment (Study-two).

The models described in Study-one and Study-two would appear to be feasible and valid for application as routine activities in the Indonesian Dental Service. Both were associated with a high degree of acceptance from the subjects involved. Notably, no individual declined to participate or dropped out of either study. There are several possible reasons for this level of cooperation. The examination procedures were painless and quick; there was ready access of subjects to the study location; subjects were familiar with the study setting; and the procedures were regarded as an integral part of dental attention, not research per se.

It is thus apparent that these evaluation models have several desirable public health features, such as validity, simplicity, practicality, efficiency in cost and time, feasibility and a high level of subject

acceptability. Nevertheless, a critical aspect yet to be considered is the acceptance of such models across the Indonesian Dental Service. Thus, there is a need for a further pilot study to test this aspect in a broader field setting.

It may be desirable, in the context of a broader pilot study, for there to be participation of the Indonesian dental administration in the evaluation process. The involvement of key staff from head-office, as well as selected field dentists and nurses, should ensure that appropriate modifications were introduced to the models prior to their more general introduction. Indeed, perhaps it may be considered desirable for the broader pilot study to be evaluated by a committee with representation from key administrators and field personnel.

The location of the pilot project should be broad enough to cover a wide range of field situations. Perhaps a Regency near Jakarta would be appropriate for this purpose. This pilot area could also be used to field test other systems for monitoring a broad range of parameters, such as dental disease trends, numbers of patients treated per operator, the service output per operator, the 'service mix', and other aspects indicative of the compliance of staff with service policy. It might be considered appropriate in this context to investigate the use of carbonized copies of examination records, as employed in the SA-SDS, since this approach has been found to be an efficient and effective means of obtaining data for monitoring purposes (Barmes, D., 1983; P.A.C., 1980; Roder, D., 1980).

It is realized that there are many constraints, such as geographical isolation and limited financial resources, that would tend to impede the development of an effective nation-wide monitoring system in

Indonesia. It is possible that a national system might best be introduced in a stepwise fashion. For example, it might be appropriate for those staff included in the evaluation of the broader pilot study to act as consultants to staff at the Provincial level, who could then act as consultants to staff at lower organizational levels, and so forth.

Clearly, a decision on whether to introduce such a system should rest on the results of a broader pilot study. Furthermore, the continuation and coordination of a monitoring system, once established, would depend on the cooperation of the individual dental staff (Baker, F., and McPhee, C., 1979). Schulberg has pointed out that a certain degree of resistance can be expected where fear of a loss of professional status is likely to be a central feature. This was apparent in the SA-SDS when its system for monitoring performance was first introduced (Roder, D., 1984; Burrow, D., 1984; personal communications).

In order to increase professional compliance, it may be appropriate to encourage participation of staff in the formulation of quality standards. For the evaluation models reported in this thesis, the formulation of standards should not lead to undue controversy. The models only apply to the diagnosis of common oral conditions and to very basic hygiene services.

A 'reward system' could be a product of the monitoring system, insofar as it would be possible to recognize and acknowledge good performance in timely feedback reports. Comparative information on the performance of village personnel within a Sub-district, or of Sub-districts within a Regency, or of Regencies or Provinces could also act as an incentive for good performance. In addition, through a two-way

transfer of information, dentists, dental nurses, cadres and school teachers could be reminded of their importance in the national dental endeavour. This would be consistent with the country's national philosophy of emphasizing a cooperative social endeavour.

For the development, coordination and maintenance of an effective monitoring system, a central Research and Evaluation Unit would seem to be imperative. Such a unit could be used for a broad range of planning purposes. In Indonesia, where there is a commitment to innovative approaches for oral health care, such a unit would have a special significance, particularly as there is a need to make optimum use of the scarce resources available for dental care. The priority given to the further development of a central Research and Evaluation Unit should accord with the priorities assigned to the development of the National Health Information System in the current Five-year Development Plan (1985-1989). It should also be consistent with the need perceived by the Indonesian Directorate of Dental Health to develop an effective and an efficient information system (Siagian, B., 1984).

In this context, it might be appropriate to consider the transfer of selected technology from other services, such as the SA-SDS. Notably, the SA-SDS has been exposed to a rigorous evaluation of its effectiveness, efficiency and appropriateness. However, while technical input from international sources could prove useful, decisions on the adaptation of this technology to Indonesian circumstances would best be achieved by Indonesians.

For the satisfactory performance of an information system, a certain amount of staff training would be needed. This could range from

very simple training of cadres to comprehensive training in information systems for staff at the central administration level. The need for oral health manpower to be trained in dental public health administration is also self-evident, particularly as the Indonesian dental care system is becoming more orientated towards community care (Ministry of Health, Indonesia, 1982). As more dentists and dental nurses enter community services, training in public health will become an increasingly important aspect of basic educational courses.

V. CONCLUSIONS AND RECOMMENDATIONS

1. Models for monitoring the performance of cadres and teachers have been developed and field tested in Indonesia.

2. The models have proved to be practical and effective means of monitoring aspects of performance relating to the detection of carious lesions, gingivitis and calculus, the referral of individuals for emergency care, and the removal of calculus and provision of accompanying oral hygiene instruction.

3. A broader pilot study covering a wider range of field circumstances is recommended before these models are considered for general application.

4. These models may be applicable in other countries where dental systems employ cadres and other non-dental staff to provide selected services.

Appendix I.1: Concepts Relating to the Aetiology and Control of Periodontal Diseases

The aetiology of periodontal disease is not yet fully understood. It has been generally accepted that periodontal disease is caused by microorganisms in the dental plaque and that destructive periodontal disease is an extension of gingivitis. However, this view has recently been questioned (Socransky, S., 1984; Goodson, J. et al., 1982; Haffajee, A. et al., 1983; Lindhe, J. et al., 1983).

Changing perceptions of the natural history of periodontal disease will clearly have a bearing on the planning of dental care in Indonesia and elsewhere, with important implications regarding the use made of public resources. In this Appendix, there is a brief review of current concepts on the pathogenesis and control of periodontal disease.

The validity of assumptions based on earlier epidemiological data gathered using the indices of Russell and Ramfjord has been queried. As a result of the use of mean index scores, the prevalence of various stages in disease progression was not always apparent from these data (Page, R., and Schroeder, H., 1982; Socransky, S., 1984).

Recent epidemiological findings have shown a very high prevalence of gingivitis among the young, but a much lower prevalence of destructive periodontal disease in older age groups. This has suggested that only a small percentage of gingivitis cases may progress to advanced disease (Hugoson, A., and Rylander, H., 1982; Ramfjord, S., 1984; MacPhee I., and Muir, K., 1980; Socransky, S., 1984).

A recent report of a three-year longitudinal study suggested that, despite a relatively high prevalence and incidence of gingivitis in the study population, there was a lack of evidence of progression to pocket formation during the study period (Listgarten, M. et al, 1985).

There appears to be a general agreement that gingivitis is very prevalent among the young. Further, most epidemiological studies have indicated a high prevalence of calculus deposits in adults. However, the prevalence of severe periodontitis has generally been found to be relatively low.

Recently, doubts have been raised about the traditional view that destructive periodontal disease is a slow but continuously progressive disorder. Results from several longitudinal studies have tended not to support this traditional concept. In particular, studies by Goodson (1982), Socransky et al. (1984), Haffajee et al. (1983) and Lindhe et al. (1983) have indicated that the disease tends not to progress continuously and slowly. Rather, it appears to advance in episodic bouts. It has been shown that periodontal disease randomly bursts into phases of destruction, which are then followed by periods of inactivity. This cycle may occur once or on a repeated basis.

Goodson et al. (1982) observed, after one year of monthly monitoring of 1,155 periodontal pockets, that 83% remained stable, 12% regained some attachment, whereas only 6% became demonstrably deeper.

A study by Haffajee et al. (1983) yielded confirmatory findings, as did a six-year longitudinal study by Socransky et al., (1984). Notably, these findings were supported by those from animal studies (Schroeder, H.,

and Lindhe, J., 1975, 1980). These observations do not appear to be consistent with the traditional concept that peridontal disease is a slowly progressive disorder.

Another generally accepted concept is that destructive periodontal disease is caused by specific plaque organisms. However, Clarke and Carey (1985) have postulated that the disease is more a function of environmental factors, such as diet, stress and smoking, which impair the host defence mechanism, thus allowing the plaque-associated gingivitis to progress into periodontitis. Bacteria are therefore thought to be of secondary importance only. Such a concept would necessitate a profound change in the prevention and treatment of periodontal disease.

The importance of oral hygiene in the prevention and control of periodontal disease has been stressed on numerous occasions by many authorities (Suomi, J. et al., 1971; Ainamo, J., 1984; Horowitz, H., 1980; F.D.I., 1984; Axellson, P., and Lindhe, J., 1981a, 1981b; Löe, H., 1980; Theilade, E. et al., 1966; Löe, H. et al., 1965; Gjermo, P., 1984; Lang, N., 1983). In addition, many have emphasized the importance of regular scaling to remove hard deposits, which may otherwise predispose to periodontal disease (Lang, N., 1983; Ramfjord, S., 1980; Hughes, T., 1978; Horowitz, H., 1980).

Oral hygiene instruction is a basic strategy that can be incorporated into a general health education programme. This instruction can be carried out by lay people. On the other hand, regular scaling programmes require specially trained staff and equipment.

In developing a strategy for the control of periodontal disease on a community basis, some workers have felt that it would be unrealistic to prevent or treat all periodontal disease. Rather, they feel that emphasis should be placed on the degree of disease control necessary to maintain a functioning dentition for life (Sheiham, A., 1984; Pilot, T., 1984; Burt, B., 1985, 1983; Craft, M., 1984). Based on recent findings on the progression of periodontal disease, Burt (1985), Sheiham (1984) and Gjermo (1984) have proposed that a certain level of disease and poor oral hygiene (gingivitis, calculus and debris) could be accepted for practical purposes as normal. The need for all calculus to be removed, with six-monthly monitoring of the patient, has also been questioned (Listgarten, M., 1985; Sheiham, A., 1984). Furthermore, if periodontitis is indeed a site-specific lesion that occurs in random bursts (instead of a generalized, continuously progressive disease), prevention of all gingivitis as a means of preventing the periodontitis may be too indiscriminant.

Changing concepts of disease control will affect dental service strategies as well as workforce planning. A high-risk strategy has been proposed by Sheiham (1984), whereby attention would be focussed on those people deemed to be at high risk. Under these circumstances, there could be general community-wide health promotion, with treatment being reserved for those individuals thought to be at risk of advanced destructive disease (Sheiham, A., 1984). However, at present, there do not appear to be sensitive and specific means of identifying these high-risk groups.

Indonesia will need to stay abreast of these changing concepts of disease control, and monitor the outcomes of services closely, if there is to be a carefully considered use of public resources.

Appendix II.1 Dentist and Dental Therapist Duties - SA-SDS 1978

I Introduction

Duties of dentists and therapists employed in the South Australian School Dental Service have been outlined in the document entitled 'Dentist and Dental Therapist's Duties', which was first released in 1978. The document outlines the responsibilities and working relationship that should exist between different types of personnel in the SA-SDS. This document includes policies on examination and treatment protocols for therapists and dentists. It is reviewed briefly in this appendix. It should be noted, however, that due to the changing pattern of dental diseases in the South Australian school population, this document is presently under review (Dooland, M., 1985 personal communication).

II Examination Policy

It is the policy of the SA-SDS for all enrolled children to be examined by a dentist as soon as possible after enrolment and thereafter at maximum intervals of two years. In addition, all children must be examined by a dentist or therapist at least once per annum.

The dentist is required to examine at least 15 patients of each therapist annually to assess the accuracy of the therapist's diagnoses and treatment planning, and to provide other general supervision of the quality of the care provided and the effectiveness of oral hygiene instruction.

Dental therapists should endeavour to examine children immediately prior to the dentist's initial examination. Therapists are responsible for the diagnosis and recording of carious lesions, the assessment of oral hygiene status and gingival health, the detection of

other abnormalities, and the planning of treatment within their scope of training.

III Emergency Dental Care

Cases requiring immediate attention, including those with acute infections, fractured teeth and the need for relief of pain should be referred by therapists to the dentist. In the event that the dentist cannot attend to the patient immediately, the therapist may place sedative dressings for vital teeth, cap traumatically exposed pulps and reimplant avulsed teeth. The dentist would then be responsible for any subsequent emergency treatment.

IV Dental Therapist Duties

In addition to the delivery of dental treatment, the therapist is expected to prevent dental diseases by promoting favourable behavioural patterns. Therapists should endeavour to include teachers, parents and canteen supervisors in these promotional programmes.

Therapist duties comprise: (1) dental health education at the chairside and in the classroom; (2) oral prophylaxes, topical applications of fluoride materials and the applications of fissure sealants; (3) the preparation of cavities and placement of fillings (primary and permanent teeth); (4) the mummification of the vital pulps of primary teeth; (5) the extraction of primary teeth; and (6) the taking of impressions and preparation of study models. Other duties include the maintenance of clinical reports, the management of stores, the supervision of dental nurses, and miscellaneous administrative duties.

V Dentist Duties

Dentists in the SA-SDS are categorized as Field Dental Officers (FDO's), District Dental Officers (DDO's) and Regional Dental Officers (RDO's). Their duties are to provide general dental care, beyond the scope of the dental therapist. In addition, there are specific administrative duties that the DDO's and RDO's must assume in the provision of care to defined geographic areas. For example, DDO's and RDO's are responsible for the planning, administration and management of the School Dental Service in their respective catchment area. This includes the monitoring of the performance of the dental therapists and the provisions of necessary counselling.

Appendix II.2 The Standardization of Clinical Organization (Dental Health Services, 1980).

Standardization of the organization of SA-SDS clinics was introduced to facilitate the transfer of staff between clinics. However, there were also the following secondary objectives: (1) to increase administrative convenience; (2) to facilitate the monitoring of services; (3) to maintain an acceptable quality of care; and (4) to improve the efficiency of the organization.

The standardization covered the following aspects of 'structure' and 'process': (1) methods of communication at the central office and clinics; (2) the management of clinic records, such as clinic registers, treatment cards, patient recall notices, and therapist day books; (3) routine reviews of the quality of clinical services; (4) the provision of care, including the setting of priorities for individual items of care; (5) the lay-out of clinical instruments; and (6) the provision of data for the SA-SDS information system. Uniform precoded forms were introduced to facilitate data recording and analysis.

Although the standardization process would increase the overall efficiency of the organization, the SA-SDS also recognized that standardization would tend to decrease flexibility and autonomy at the field level. The approach taken was aimed to strike a balance between the competing needs.

Appendix II.3 Exam Sheet and Instructions

The 'exam sheet' includes information of a general nature, such as clinic name and identification number, operator number, patient's general identification and date of enrolment, data on caries incidence and experience, oral hygiene and calculus status. To obtain precise and reliable data, coding instructions have been distributed to all staff. These include definitions of operational terms, examination codes, and other relevant information. The data are considered to be sufficient to facilitate assessments of the performance of the SA-SDS programme.

Data are obtained from every third patient by taking carbon copies of examination records. The copies are collected, checked and then sent to the Research and Evaluation Unit on the first and fifteenth day of the month for processing. Feedback reports are sent to the respective clinics and summaries are provided for the individual districts, regions, and state as a whole.

Appendix II.4 Therapist's Day Book, Dentist's Day Book, and Information on Productivity

Day books are the principal means of maintaining records of the services provided in the SA-SDS. Carbon copies are sent to the Research and Evaluation Unit for the following assessments:

(1) Therapist's day book: the number of services provided, by type of service, and the aggregate time units of care provided (N.B. each item is assigned a standard time unit). The findings can be compared with the clinical priorities assigned and targets for the overall output of care.

(2) Dentist's day book: the total numbers of hours spent on each area of dentist responsibility.

In addition, the fee-for-service value of the care provided is calculated using the guidelines for fee assessment provided by the Australian Dental Association (South Australian Branch).

Statistical feedback on the productivity of each operator (expressed in time and dollar units), and the mix of services provided, is sent to the respective clinics, districts and regions at least three times each year for comparative assessment. Hence, the efficiency of the SA-SDS and extent of compliance of staff with central policies can be monitored locally. Meanwhile, the system facilitates central overseeing. Analyses of cost-effectiveness can be undertaken by applying fee-for-service schedules to the items of care provided.

Appendix II.5 Assessment of Clinical Quality

Quality assessments are used as an indirect indication of the effectiveness of the service provided by the SA-SDS. Two fundamental processes are used for this purpose, namely: (1) formal duplicate examinations of samples of patients by therapists and respective DDO's; and (2) formal reviews of clinical treatment cards. It is intended that these processes be completed once a year. They will be discussed briefly.

In the examination reviews, therapists select 15 of their patients at random so that three children come from each of the school grades three to seven. Duplicate oral examinations by the therapist and the DDO and treatment-card reviews are performed for each selected child. A set of standardized survey procedures and precoded forms have been developed by the Research and Evaluation Unit and distributed to all clinics to facilitate this review process.

The information collected from the oral examinations includes: (1) the presence of carious lesions, categorized as those in need, those possibly not in need of care, and lesions that are so large that they should have been detectable nine months previously; (2) the quality of restorations, rated as unsatisfactory (in need of replacement), as having definite defects but where replacement would be unnecessary, as having a slight defect needing only recountouring and polishing for correction, or as satisfactory; (3) oral hygiene status by quadrant; and (4) whether there is a need for a radiographic examination. Comparisons are drawn between the dentist's examination findings and those of the therapist. Divergences can become the subject of follow-up discussion and review.

A more indirect monitoring of quality is achieved by reviewing treatment cards. The following indicators are frequently used in this context:

(1) the completeness of treatment in relation to the diagnoses and treatment plans recorded.

(2) the number and the quality of radiographs exposed.

(3) the completeness of the recorded medical histories and their updates.

(4) evidence of examinations at prescribed times by dentist and therapists.

The following indicators are also used in relation to examination records:

(1) the number of teeth recorded as having untreated carious lesions and the number actually treated.

(2) the number of restorations by quality ratings.

(3) the number of children with poor oral hygiene status.

Data are forwarded to the Research and Evaluation Unit and statistical feedback is sent to the respective RDO. Follow-up remedial action is taken, as necessary.

Appendix III.1

Recording Form for Examination Survey (Study-One)

NAME:

SERIAL NO: 1 2 3

AGE: 4 5

SEX: 6

SCHOOL: 7 8

OPERATOR NO.: 9

CARIES: 11 12 13 / 14 15 16

CALCULUS: 17 18 19 / 20 21 22

GINGIVITIS: 23 24 25 / 26 27 28

NOTES

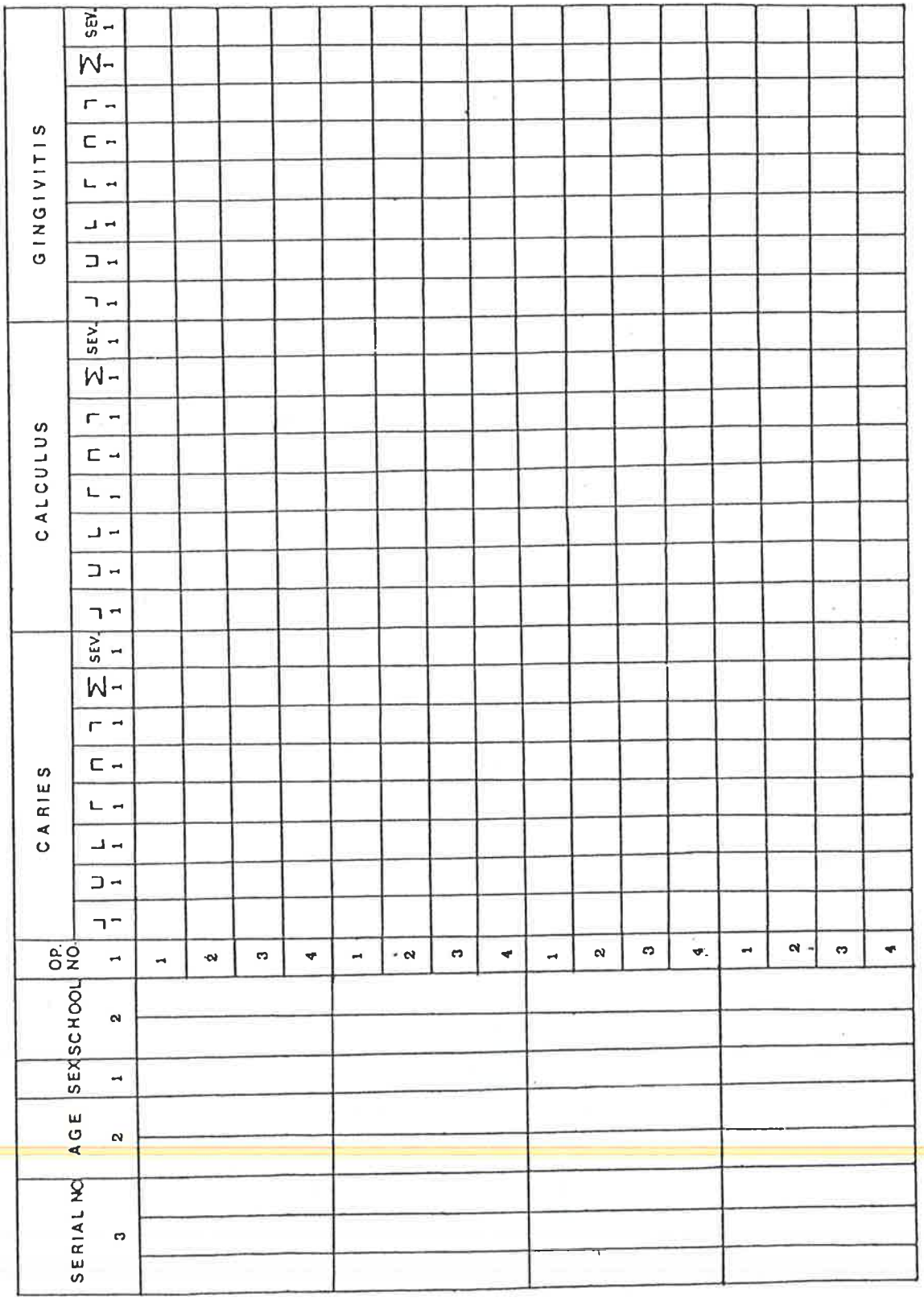
OPERATOR NO:
1 - INDEX DENTIST
2 - DENTAL NURSE
3 - CADRE
4 - SCHOOL TEACHER

CRITERIA OF SCORING: (FOR OPERATOR NO. 2, 3 AND 4)

CARIES	CALCULUS	GINGIVITIS
0 - ABSENT	0 - ABSENT	0 - ABSENT
1 - PRESENT	1 - PRESENT	1 - PRESENT
2 - EMERGENCY		

Appendix III.2

Data Recording Form



Appendix III.3

Proforma to Facilitate Calculations of Sensitivity,

Specificity and Predictive Value for Caries Assessments

Mouth Score	No. of Children	Dentist Marker						No. of Children	Dental Nurse Marker			
		Nurse		Cadre		Teacher			Cadre		Teacher	
		C	NC	C	NC	C	NC		C	NC	C	NC
3		* / **		* / **		* / **			* / **		* / **	
2		* / **		* / **		* / **			* / **		* / **	
1		* / **		* / **		* / **			* / **		* / **	
1 - 3		* / **		* / **		* / **			* / **		* / **	
0		* / **		* / **		* / **			* / **		* / **	

* Emergency care required.

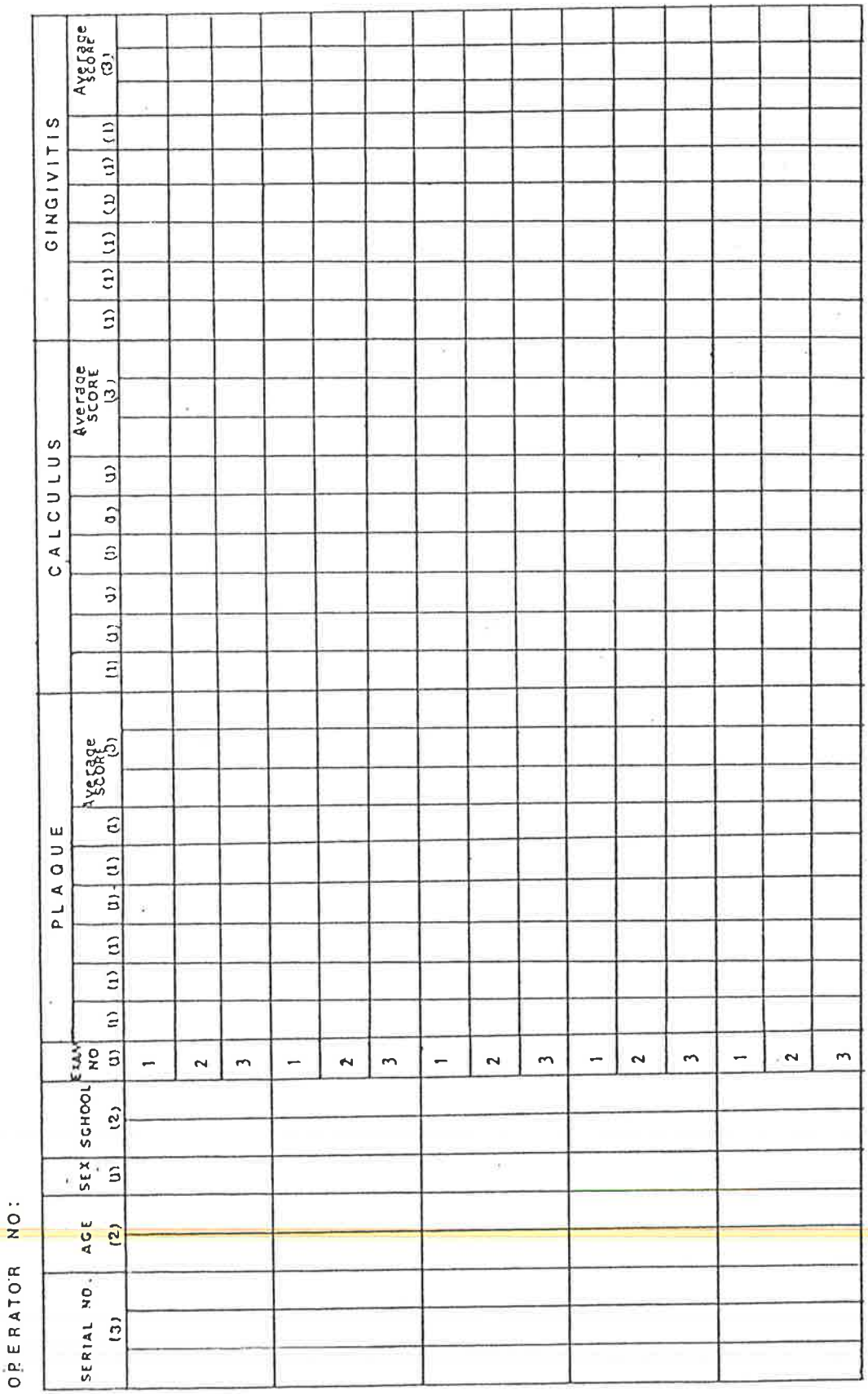
** Emergency care not required.

NB: C = Caries found.
NC = Caries not found.

Modified proformas could be used for gingivitis and calculus assessments.

Appendix III.4

Calculus Removal Assessment Recording Form



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